The Engineer

LONDON, FRIDAY, JANUARY 3, 1941.

PUBLIC NOTICES

I.C.I. (GENERAL CHEMICALS) LIMITED

POWER DEPARTMENT

Applications are Invited for the POSITION of SHIFT MANAGER in the Company's Power Stations.

The duties will comprise the management of a shift operating modern power station equipment, including high-pressure water-tube boilers, turbo-alternators, E.H.T. switchgear, &c., and applicants, who should be not less than 33 years of age, must have had several years' responsible experience in such work, following a sound practical and technical training in mechanical and electrical engineering.

The commencing salary is £400 per annum; the appointment is subject to a three months' probationary period, and the selected candidate will be required to pass a medical examination.

Applications, giving age and full particulars of education, engineering training and power station experience, should be addressed to I.C.I. (GENERAL CHEMICALS), LTD., POWER DEPARTMENT, c/o CASTNER-KELLNER WORKS, WESTON POINT, RUNCORN, CHESHIRE, marked "S.M." 6828

GOVERNMENT OF THE PUNJAB

INDIA

Applications are Invited for THREE APPOINTMENTS of ASSISTANT EXECUTIVE ENGINEER in the Punjab Service of Engineers, Class 1. Candidates must be European British subjects of non-Asiatic domicile, and must have attained the age of 21 and have not attained the age of 24 years on the 1st August, 1940. They must possess one of a specified list of University Degrees or other qualifications. Permanent and pensionable appointments subject to two years' probation, with prospects of advancement to the highest posts in the Service. Initial pay, Rs. 300 per mensem, plus overseas pay Rs. 150 per mensem (total equivalent to £405 p.a. approximately). Free passage to India and if confirmed in appointment, further passages for purposes of leave. Further particulars and forms of application may be obtained on application by postcard, quoting Appointment 1/11/A, from the HIGH COMMISSIONER FOR INDIA, GENERAL DEPARTMENT, INDIA HOUSE, ALDWYCH, LONDON, W.C.2. Last date for receipt of applications 24th January, 1941. 6842

CITY OF COVENTRY

WATER DEPARTMENT

APPOINTMENT OF ENGINEERING ASSISTANT

Applications are Invited for the POST of ENGINEERING ASSISTANT at a salary (on General Grade 1 of the Council's salary scale) of £260 per annum, rising, subject to satisfactory service, by annual increments of £15 to £350 per annum (with the addition of a temporary cost-of-living bonus at the rate of 6 per cent. upon the first £300 of salary per annum and 3 per cent. upon the remainder).

All appointments made during wartime are, under the Council's rules, to be temporary only and for the duration of the war.

Candidates, who must not be over 40 years of age must be competent surveyors, levellers, and good draughtsmen, and should be qualified by examination.

The person appointed will be required to pass a medical examination, to contribute on the approved scale to the Superannuation Fund established by the Council under the Superannuation Acts, and to devote the whole of his time to the duties of the appointment.

Applications, endorsed "Engineering Assistant," stating age, qualifications, present occupation and experience, and accompanied by copies of not more than three recent testimonials, must be delivered at the office of the undersigned not later than Thursday, the 23rd January, 1941.

Canvassing, either directly or indirectly, will be a disqualification.

NORMAN J. PUGH,
Assoc. M. Inst. C.E., M. Inst. W.E.,
Water Engineer and Manager.

Council House,
Coventry.
December 30th, 1940. 7021

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS 1940 No. 877

RESTRICTION ON ENGAGEMENT ORDER

WANTED, FOREMAN PLATELAYER for Large Iron and Steel Works; must be thoroughly competent in Laying and Maintaining Rail Roads. Applicants must furnish full particulars and experience and state wages required.—Address, 6836, The Engineer Office. 6836 A

ENGINEER for a New Project REQUIRED. Good prospects for right man, now and after the war. Must have extensive Engineering Experience, particularly as Engineer to Foundries, and be able to negotiate with Government Departments, Building Contractors, Plant Suppliers, Local Authorities, &c. Would be required to Take Charge of Building Work, Lay-out and Installation of Plant, and Engineering Drawing Office and Staff. Experience with Modern Hydraulic Equipment and Presses, Heavy Sheet and Strip Rolling Mills, would be an advantage. Give full particulars of training and experience, salary required, and when free.—BIRMETALS, Limited, Woodgate Works, Quinton, Birmingham, 32. 7016 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE
ARRANGED FOR CARD INDEXING
(TABLE OF CONTENTS, PAGE 10)

A Retrospect (P. 10)
THE ENGINEER, 3 - 1 - 41

The Economic War and the Engineering Industry (P. 2)
(A. M. DE NEUMAN) THE ENGINEER, 3 - 1 - 41

Civil Engineering in 1940—No. I (P. 4)
THE ENGINEER, 3 - 1 - 41

Aeronautics in 1940 (P. 7)
THE ENGINEER, 3 - 1 - 41

Shipbuilding and Marine Engineering in 1940—No. I (P. 14)
THE ENGINEER, 3 - 1 - 41

Naval Construction in 1940—No. I (P. 13)
(F. McMURTRIE) THE ENGINEER, 3 - 1 - 41

Electrical Engineering in 1940—No. I (P. 16)
THE ENGINEER, 3 - 1 - 41

SEE PAGE 17

INDEX TO ADVERTISEMENTS, PAGE 75

IMPORTANT NOTICE

All correspondence dealing with Editorial, Advertising and Subscription Matters should be addressed to: 28, ESSEX STREET, STRAND, LONDON, W.C. 2

Remittances and Letters dealing with Accounts should be sent to:

"THE ENGINEER," Accounts Dept.,
***c/o* The Pitman Press,**
Lower Bristol Road,
Bath, Somerset.

SITUATIONS OPEN

FOUNDRY MANAGER WANTED by Old-established Engineering Company in Yorkshire. Well-equipped Ironfoundry—Loam, Dry and Green Sand—Castings up to 12 tons. State age, qualifications, and salary required.—Address, 7015, The Engineer Office 7015 A

MACHINE SHOP SUPERINTENDENT REQUIRED by up-to-date progressive London Engineering Firm manufacturing Medium Heavy Machine Tools with modern plant, equipment, methods and production system. Practical experience of all classes of machine tools essential and preferably also knowledge of jig and tool manufacture. Applicant must be accustomed to the control and training of labour. Approximately 200/250 machinists with under-foreman. Salary according to qualifications. Excellent opening and future for keen up-to-date man.—Address, giving full particulars of career, age, &c., to date, 7019, The Engineer Office. 7019 A

THE Post You Are Seeking May Not be Advertised in this Column, but do not lose the Opportunity of Bringing Your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for a cost of Four Lines, 4s.; 1s. for each Additional Line. There is no better way of covering so large a field for such a small charge.

SITUATIONS OPEN

WORKS MANAGER REQUIRED for Factory engaged on Machining Aircraft Details and the Erection of Aircraft Assemblies. Only men with experience in detail planning need apply. This position is for a firm of good standing in the South Midlands.—Applicants should state full details of past experience and present position to Box No. 3346, T. B. Browne's Advertising Offices, 163, Queen Victoria Street, London, E.C.4. 7017 A

SITUATIONS WANTED

A.M.I.C.E., A.M.I.M.E. (50), Railway Locomotive works, D.O., running shed training, wide experience public works and general engineering, experience reorganisation, control of staff, resource and initiative, applicable to many industries, at present chief engineer, municipal transport system, electric traction, I.C. and C.I. engines, DESIRES CHANGE.—Address, P3001, The Engineer Office. P3001 B

ENGINEER (34 Years), A.M.I. Mech. E., SEEKS EVENING or WEEK-END WORK to replace lost income as evening technical lecturer. Accurate and rapid draughtsman and estimator. Would undertake supervising machine operations or skilled assembly if attractive payment offered. London area.—Address, 6840, The Engineer Office. 6840 B

COMPANY MEETING

FOSTER, YATES & THOM

A RECORD YEAR

Taxation's Heavy Demands

The FOURTH GENERAL MEETING of Foster, Yates and Thom, Limited, was held on Tuesday, December 31st, in London.

SIR GEORGE COCHRANE GODFREY, A.M. Inst. C.E., M.I.E. (Ind.) (the chairman), in the course of his speech, said: "You will see that while the trading profit at September 30th, 1940, was £36,335, as against £28,393 for the previous year—an increase of £7942—the amount available for allocation is only £10,979, as against £13,201 available for 1939. This is due to the fact that we have now to make provision for greatly increased taxation, which calls this year for a reserve of £12,000, as against the previous figure of £7600. This figure has not yet been agreed by the taxation authorities, but is the present calculation for income tax and excess profits tax. It has been considered prudent by your directors for an additional sum of £2400 to be set aside for depreciation in order to compensate for the longer hours of working to which your plant and equipment must be subjected under war conditions. Your directors also consider it advisable that, of the balance of £10,979, £2500 be placed to repairs and renewals reserve. The directors recommend a dividend of 5 per cent. on the Ordinary Shares and to carry forward an amount of £1579.

The general reconstruction work which was scheduled to have been completed during the year under review has naturally had to be subordinated to some extent by war conditions and the urgency of output, but the work has been proceeding steadily and the results already evident of increased production, improved quality, and lower costs provide ample justification for the expenditure incurred.

I am glad to be able to tell you that record figures have been achieved this year under every head. We are now employing more labour than at any time in the history of the company; our output capacity has increased nearly 100 per cent., and the whole organisation is based upon modern up-to-date lines which accord with the gradual change-over to heavy precision engineering that has been taking place over the past two years. I need hardly assure you that your company is doing its utmost in support of the national war effort.

Last year I told you that the management were fully alive to the necessity for development work designed to place your company in a good position to face the immediate post-war period of change to normal activity. This subject is being examined as opportunity occurs, but it is not possible at present to allocate special staff to the preparation of detailed schemes and plans. Plans are already in hand, and work upon design is proceeding as steadily as can be expected in the face of staff difficulties, which, already considerable, will become greater as even more men are called to the Colours.

Even immediate development work is somewhat hampered by the excess profits tax, since such work is not allowed as a normal trading expense in arriving at the figure for the year. This is an instance of the danger of the present excess profits tax. I agree that the nearer this country can come to paying its way in this war the easier will be the post-war financial recovery. But in spite of that I deprecate very strongly the increase of the excess profits tax from 60 per cent. to 100 per cent., not on account of the enforced lower return to shareholders, but for the two very cogent reasons that it encourages extravagance in working expenses and discourages the placing to reserves of substantial sums for development and reconstruction.

In conclusion, I would say that your company has made considerable strides during the past year and with the completion during 1941 of the present improvements programme we should be in a strong position to meet competition in a far wider field than has hitherto been possible.

The report was unanimously adopted.

SITUATIONS WANTED

AN ENGINEER, University Graduate, Mechanical and electrotechnical, with several years' apprenticeship and experience in workshops as well as sales developments with well-known firms, comprehensive knowledge of British and Continental patent practice, good general education, perfect knowledge of Russian, French and German, and proficient knowledge of Spanish, WISHES to IMPROVE his present POSITION and is ready to take up a new job early in the year.—Address, 7020, The Engineer Office. 7020 B

ENGINEER and MANAGER of Important Industrial undertaking in South Africa DESIRES SIMILAR APPOINTMENT any part of the world. Would be interested in Manufacturing Concerns, Mining Machinery, Marine or General Engineering Works or large Hydro-electric or other Power Station. Wide technical and commercial experience, full qualifications, and highest credentials. Age 48, Scot, married. Salary required equivalent to £1200 per annum in U.K. Exempt military service.—Address, P2767, The Engineer Office. P2767 B

For continuation of Small Advertisements see page 76

AUCTIONS, Page 76

PATENTS, Page 76

SUB-CONTRACTING, Page 76

FOR SALE, Page 76

MACHINERY, &c., WANTED, Page 76

MISCELLANEOUS, Page 76

EDUCATIONAL, Page 76

For Advertisement Rates see First Column Overleaf

CLASSIFIED ADVERTISEMENTS CLOSE FOR

PRESS—NOON WEDNESDAYS

The Engineer

Annual Subscription Rates

(including postal charges)

Le prix de l'abonnement est accepté en livres sterling, ou dans la monnaie du pays d'origine au cours du change au moment de la commande.

Die Bezugsgebühren sind zahlbar in Pfundsterling oder in der Landeswährung des Bestellers, umgerechnet zum Kurse des Tages an dem die Bezahlung erfolgt.

Serán aceptados los abonos en moneda esterlina o su equivalente calculado en la moneda del páis de origen al cambio efectivo a la fecha de ponérse el pedido.

BRITISH ISLES ...	£3 5 0	
CANADA	£3 3 0	Thick Paper Ed.
	£2 18 6	Thin Paper Ed.
ABROAD	£3 7 6	Thick Paper Ed.
(except Canada)	£3 3 0	Thin Paper Ed.

AFRICA	Central News Agency. All Branches CAPE TOWN: Wm. Dawson and Sons, Ltd., 29–31, Long Street (Box 489)
ARGENTINE ...	BUENOS AIRES: Mitchell's Book Store, 576, Cangallo BUENOS AIRES: F. W. Mole, Cangallo, 456
AUSTRALIA ...	Gordon and Gotch (A'sia), Ltd. All Branches MELBOURNE: Jervis Manton, 37, Swanston Street MELBOURNE: Trade Press Proprietary, Ltd., 19, Queen Street
CANADA	American News Company, Ltd. All Branches MONTREAL: Benjamin News Company, 973, St. Antoine Street TORONTO: Wm. Dawson Subscription Service, Ltd., 70, King Street East TORONTO: Gordon and Gotch, Ltd., 253, Queen Street West
CEYLON	COLOMBO: Wijayartna and Co.
CHINA	HONG KONG: Kelly and Walsh, Ltd. SHANGHAI: Kelly and Walsh, Ltd.
EGYPT	CAIRO: Express Book and Stationery Store, 9, Chareh Maghrabi
FINLAND ...	HELSINKI: Akademiska Bokhandeln, Alexandersgatan, 7
INDIA	BOMBAY: Thacker and Co., Ltd. BOMBAY: Popular Book Depot, Grant Road CALCUTTA: Thacker, Spink and Co.
JAPAN	Maruzen Co. All Branches
NEW ZEALAND	AUCKLAND: Whitcombe and Tombs, Ltd. H. F. R. Lessingham, 55a, Shortland Street Gordon & Gotch (A'sia), Ltd., Wellington, Auckland, and Christchurch NAPIER: J. Wilson Craig and Co.
STRAITS SETTLEMENTS	SINGAPORE: Kelly and Walsh, Ltd.
SWEDEN	STOCKHOLM: A/B Wennergrens Journal-expedition, Stockholm 1 STOCKHOLM: A/B C. E. Fritzes Kungl., Hofbokhandel Fredsgatan, 2
SWITZERLAND	ZURICH: Rosa Leibowicz, 4, Ankerstr.
UNITED STATES OF AMERICA	NEW YORK: International News Co., 131, Varick Street, New York, N.Y., and all Branches Moore Cottrell Subscription Agency, North Cohocton BOSTON: F. W. Faxon and Co., 65–69, Francis Street

Entered as second-class matter at the Post Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.).

U.S.S.R.	LENINGRAD: Mesbdunarodnaja Kniga, Prospect Volodarsky, 53A MOSCOW: Kuznetski Most 18

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4/9 each, 5/3 post free.*

*** BINDING CASES, *for half-yearly volumes of* THE ENGINEER, *in cloth 5/– each, 5/3 post free.*

PAPER SUPPLIES

With a view to the conservation of paper, readers are advised, in the interests of all concerned, to place a regular order for THE ENGINEER with their newsagent or direct with the Publisher.

"THE METALLURGIST"

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next due, February 28th.

ADVERTISEMENTS

The charges for Classified Advertisements are 1/– per line up to one inch—minimum charge 4/–; those occupying one inch or more at the rate of 12/– per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address, 28, Essex Street, Strand, London, W.C.2. Teleg. Address, "Engineer Newspaper, Estrand, London." Tel., Central 6565 (10 lines).

HYDRAULIC LABORATORY EQUIPMENT

FOR

THE LESTER SCHOOL AND HENRY LESTER INSTITUTE OF TECHNICAL EDUCATION, SHANGHAI.

SPIRAL CASED FRANCIS TURBINE

WITH

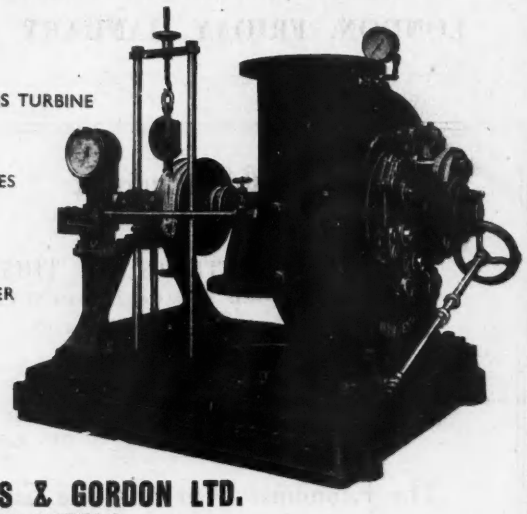
DUMMY GUIDE VANES

ROPE BRAKE

TACHOMETER

REVOLUTION COUNTER

GAUGES



GILBERT GILKES & GORDON LTD.

HYDRAULIC ENGINEERS,

KENDAL, ENGLAND.

LONDON: CRAVEN HOUSE, KINGSWAY.

W. G. BAGNALL, LTD.

STAFFORD

London Office: 32, Victoria St., S.W. 'Phone: 1882 Abbey.

BUILDERS OF LOCOMOTIVES

Weighing from 3 to 50 tons, for any gauge, of Highest-class Workmanship and Materials.

MAKERS OF

Tipping Trucks, Sugar Cane Wagons, Turntables, Switches, &c.

See Illustrated Advt. alternate issues.

LA MONT BOILERS

FOR ALL PURPOSES.

PARTICULARS FROM

LA MONT STEAM GENERATOR Ltd.,

'BELLA VISTA,' MOUNT RD., LANSDOWN, BATH.

HARRY F. ATKINS

M.I. MECH. E.

CONSULTING ENGINEER

(MACHINE TOOLS & PROCESSES)

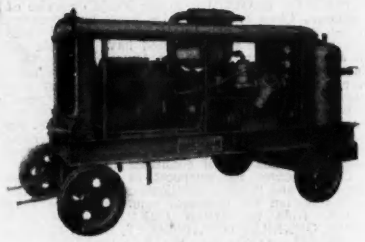
OLD FLETTON

PETERBOROUGH

WILSON

AIR COMPRESSORS

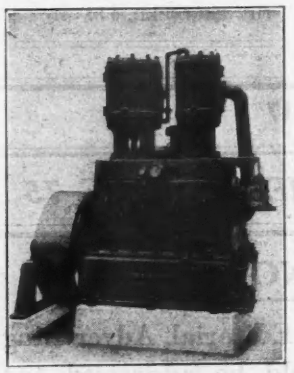
FIXED and PORTABLE PETROL, DIESEL and ELECTRIC MOTOR DRIVEN for



Portable, Two-Stage, Diesel Engine Driven Air Compressor.

PUBLIC WORKS CONTRACTORS, QUARRIES AND STONE YARDS

Belt Drive Single-Stage Air Compressor.



Pneumatic Surfacing and Polishing Machines, Pneumatic Drills and Tools. Compressed Air Motors, Stone and Marble Sawing and Polishing Machines. Cranes.

ALEXR. WILSON (ABERDEEN) LTD.

Telephone 3192 ASHGROVE ROAD, ABERDEEN Telegrams: Compressor, Aberdeen

A NEW 5-TON ELECTRIC DERRICK CRANE

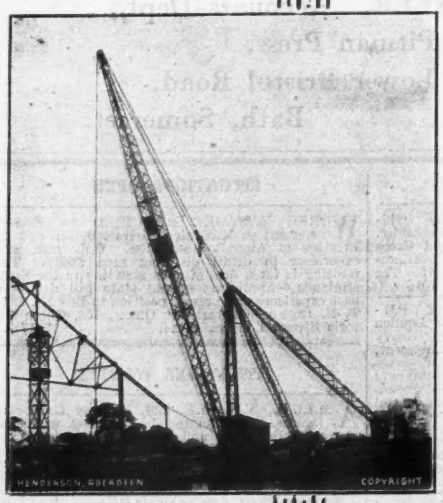
with 100ft. Jib

FOR IMMEDIATE DELIVERY

ALSO A

NEW 3-ton ELECTRIC DERRICK CRANE

with 91ft. Jib



FOR FULL PARTICULARS AND PRICE APPLY TO:

JOHN M HENDERSON & Co. Ltd.

KING'S WORKS ABERDEEN

LONDON OFFICE - 12, NORFOLK STREET, STRAND, W.C.2.

TELEGRAMS - - "CRANES - ABERDEEN."

JANUARY 3, 1941—VOL. CLXXI

THE ENGINEER

A Seven-Day Journal

The Norton Fitzwarren Accident

ON November 4th the Paddington-Penzance express of the Great Western Railway was derailed at Norton Fitzwarren, Somerset. The train was carrying about 900 passengers, of whom 25 were killed and 56 seriously injured. A fireman was also killed. The official inquiry was conducted by Lieut.-Colonel A. H. L. Mount. From his report, which was published a few days ago, it appears that the accident was due wholly and solely to an unaccountable lapse by an experienced driver. The train was running on the down relief line, but the driver was under the impression that he was on the down main, and accepted the signals for that line. Unfortunately, they were at clear for a newspaper train, and the express ran at speed into catch-points. The engine was thrown on its side and five coaches were wrecked, fouling all lines. In his remarks on the accident, Lieut.-Colonel Mount says: "It is difficult to understand the reasons for a lapse of the kind in question on the part of such an experienced driver, whose record has hitherto been one of consistent reliability; but in spite of his knowledge of the road, the erroneous impression which he gained on leaving Taunton, and retained for more than three minutes, was apparently due, in the first instance, to failure to interpret correctly a simple and well-displayed group of four signal lights. Thereafter the automatic train control warning received at the Norton Fitzwarren distant unfortunately did not have the desired effect, as it undoubtedly has in other cases (unrecorded) when accident has been prevented thereby. The issue is largely psychological; Driver Stacey was fit and did not lack rest, but I feel that his breakdown may be partly attributed to operating conditions in the black-out, and to the general strain (for example, his house at Acton had been recently damaged) which railway servants, in common with other members of the community, are undergoing at the present time."

A New Director of Works

LORD REITH, Minister of Works and Buildings, has revived the post of Director of Works, which has been in abeyance since 1927, and has appointed Colonel C. L. Howard Humphreys, of Messrs. Howard Humphreys and Sons, consulting engineers, to fill the post. The divisions of the Ministry which will be included in the new directorate are those of the Chief Architect, Chief Engineer, Chief Maintenance Surveyor, Chief Structural Engineer, and Chief Quantity Surveyor. On architectural and æsthetic questions the Chief Architect will advise the Minister direct. Colonel Humphreys is a member of Council of the Institution of Civil Engineers, of which he became a full member in 1929, and a member of the Institution of Mechanical Engineers, and of many other engineering and scientific bodies. The Army Council has agreed to release him from his military duties to take up the new post. Mr. T. S. Tait, senior partner of the firm of Sir John Burnet, Tait and Lorne, of London and Edinburgh, has been appointed Director of Standardisation in the Department of the Controller of Building Materials. The Ministry states that it is important for economy in materials and labour that the number of classifications of building materials should be drastically reduced. Standardisation has gone some way, but there is scope for its further progress.

Training Indian Mechanics

As a result of consultations between the Viceroy, the Secretary of State for India, and the Ministry of Labour, Indian workmen are to be given a course of training in engineering in this country. The scheme is complementary to the one under which more British instructors are being sent to the technical training establishments in India. The workmen to come to this country are to be not less than eighteen years of age, and semi-skilled artisans selected from Government and other factories. They are to come over in batches of fifty, and the first batch is expected at about the end of February. Each man will be given six months' training, beginning at a training centre where, under a suitable manager, a hostel will be provided for the successive groups. The men will not receive wages, but their training allowances will be sufficient to cover the cost of keep and accommodation, plus weekly pocket money. The main purpose of the scheme is to accelerate the production of munitions in India. Opportunity will be taken, however, to give the young men full insight into, and due appreciation of, the merits of industrial organisation. The Ministry of Labour hopes to inculcate in Indian workers an appreciation of the British methods of industrial co-operation between employers and workers, and the value of sound trade union principles.

Railways and the War

A REVIEW of the work of British railways during the past twelve months has just been issued officially. It says that during last January's exceptionally severe weather, 1500 miles of lines were blocked by snow, scores of trains were snowed up, hundreds of miles of telegraph and telephone wires were brought down; 300 snow ploughs were used to clear snow drifts of 15ft.; troops helped gangs of railwaymen to dig out trains; thousands of gallons of milk and tons of essential goods were moved by special trains to snowbound towns and villages. The arrival of Empire troops required additional transport, and on a single day seventy-three troop trains were run by one railway alone. During six days early in June, 360 trains, 1300 buses, and 200 trams and trolleybuses moved 111,000 children and their attendants out of London. This feat, however, was surpassed after the evacuation from Dunkirk, when, within eight days, 620 trains carried 300,000 troops without previous knowledge of their arrival at seven ports in the South-East of England; 2000 carriages were formed into a pool, the movements being directed entirely by the telephone. At the busiest time 100 trains were worked in twenty-four hours.

The Duddell and Chree Medals

THE Duddell Medal, which is awarded at intervals as a recognition of the work of an investigator, of any nationality, who has contributed to the progress of physics by the invention of an instrument or of a material used in the construction of instruments, has been awarded by the Physical Society to Professor Ernest Orlando Lawrence, of the University of California, Berkeley, for his invention and subsequent development of the Cyclotron, which accelerates individual atoms to very high speeds without the use of very high voltages. Lawrence was only twenty-nine years of age when in 1930 he conceived the idea of the Cyclotron. Speaking at a luncheon last week to mark the occasion, Professor Allan Ferguson, President of the Physical Society, said that in addition to the Duddell Medal, the Society had initiated a lecture in honour of Lord Rutherford, and it had now instituted another medal in memory of Charles Chree, a distinguished physicist and mathematician, who contributed very largely to the advancement of knowledge in the sphere of terrestrial magnetism. The medal will be awarded bi-annually to scientists of international reputation who have contributed to the advancement of knowledge on terrestrial magnetism or such allied sciences in which Chree had special interest.

Industry's Task in the New Year

THE following message from Lieut.-Col. Lord Dudley Gordon, President of the Federation of British Industries, was circulated on Monday last:—"During the closing days of 1940, the attention of the whole world was drawn first to Lord Lothian's speech, delivered for him by another, immediately before his death in America, and then to the statement on the war by the Prime Minister in the House of Commons. Both these pronouncements emphasised that 1941 must be the critical year for the British Empire and for the cause of freedom in the world. This coming crisis in 1941 can only be met by the successful endeavours of industry to supply the fighting forces, with which it is proud to be in partnership. The great industrial effort in the United States, added to our own, will ensure overwhelming superiority by 1942; but it is the industry in Great Britain which has to bear the strain and provide the main requirements of 1941. Industry will not fail to respond to this urgent call for redoubled efforts in spite of enemy attempts to terrorise and to destroy. To achieve our purpose there must be rigorous cutting down of unessential goods and services. At the same time, it is necessary to exercise the utmost care in planning in order that man power and productive resources thus released shall be quickly re-absorbed. In this effort, as in others, the Federation of British Industries has kept in consultation with the Government and will continue to give its active co-operation in order that dislocation and delay may be reduced to a minimum. I have no doubt that the coming year, stern and arduous as we may expect it to be, will lead us and the world to the success of our cause—freedom."

Government to Requisition Tankers

HIS MAJESTY'S GOVERNMENT is now, in agreement with the tanker companies, proceeding to requisition all tankers not already requisitioned by or chartered to the Government. This measure completes the requisitioning of ocean-going merchant ships by including a special class of vessel which had hitherto been left outside the requisition procedure. It involves all ships specially constructed for carrying as their main cargo liquid cargo in bulk which are traded in any of the deep-sea tanker trades. It does not include whaling factory ships or tankers engaged in local distributing or refining trades overseas. In the case of tankers now trading, the requisition will take effect on the date on which the tanker first completes her discharge after December 31st, 1940. If a tanker discharges her cargo on or before that date and is ready for service on January 1st, 1941, but has not left port, the requisition will take effect on January 1st. In the case of any tanker which on January 1st is undergoing or awaiting repairs the requisition will take effect on the date when the ship is ready for service. In the case of any tanker under construction and designed for the deep-sea tanker trade, the requisition will take effect on the date when the ship is first ready for employment. The conditions of service and rates of hire of the tankers requisitioned will be in accordance with Charter Party T 99 A (Tankers), Form T 773 and Form T 775 (Tankers). The first two of these documents are almost identical with those relating to cargo vessels, of which details were given in Cmd. 6218 (August, 1940). Form T 775 (Tankers) relates to rates of hire and has not previously been published; particulars may be obtained from the Ministry of Shipping. A review of the rates and conditions may be claimed either by the Minister or by the Chamber of Shipping at any time, and in particular if circumstances change so materially as to create a new situation so far as rates of hire are concerned. Whilst the basis of the requisition will therefore be one of time charter, the Minister of Shipping desires that the companies concerned will meet, on his behalf, all time charterers' disbursements under Charter Party T 99 A (Tankers), including bunker and port charges, as though the requisitioned tankers were running for the companies' own private account. The Minister authorises the companies to collect on his behalf the freight at controlled rates on cargoes carried in requisitioned tankers and to reimburse themselves from these moneys in respect of time charterers' disbursements made by the companies on the Minister's behalf. The Minister confidently relies on the willing co-operation of the companies in managing the requisitioned vessels and looks to them to conduct the business with as much zeal as if their own interests alone were involved.

The Economic War and the Engineering Industry

By Dr. A. M. DE NEUMAN

THE economic war has many aspects. When our R.A.F. bombs the naval yards at Hamburg or the blast-furnaces at Essen, when our Navy stops neutral ships at the contraband control stations in order to prevent any raw materials or products from reaching the enemy, when the United Kingdom Commercial Corporation buys up a large parcel of Turkish commodities which otherwise would find their way to Germany or Italy, all these are forms taken by the aggressive economic war. They are parts of our effort to deny to the enemy the use of material resources and armaments. All these acts, whether financial, naval, or belonging to the aero-economic warfare, have one clear feature in common—they are distinctly aggressive, forming part of our offensive weapons.

But there is no offensive without defensive. In order to win this war an enormous effort has to be undertaken in this country. Our soldier must be properly equipped in the latest and most efficient weapons and means of communications, he must have an abundance of ammunition, food, clothing and comfort. Our Navy must be constantly replaced, increased and the various floating units overhauled and repaired. The Air Force must keep pace with that of the Axis and ultimately exceed that in numbers and skill as it excels it already in spirits. Finally, our civilian population must be fed, maintained and defended. All this indicates the enormous variety of problems which are created by our defensive economic warfare.

The old tag that the soldier and worker mutually supplement each other is just as true to-day as, indeed, in all the major wars of the past. True, at the beginning of this war there was a pernicious tendency to imagine that we could defeat the Nazis by sheer weight of economic superiority. That belief led us to adopt a too slow rate of armaments and it gave us a false sense of security, for which we have to pay to-day with a redoubled effort in all directions.

But just as the notion that you could defy the Axis by alone possessing a superiority in resources was mistaken, similarly it is an error to underrate the importance of having to strain every nerve in putting all our available resources and man power to the use of war. The initial trouble was not that we did not possess the resources, but that we did not transform them with sufficient rapidity for the need of modern war. The epic of Dunkirk is, from this point of view, something much more than the story of a magnificent retreat. It is a revolution in the whole outlook on how this war is going to be conducted. It brought home to every Englishman and every Englishwoman the truth that this is no longer going to be a "comfortable" war and that everyone will have to put his back into it. This is also part of the general economic warfare.

British Iron and Steel and Engineering

As our economy is being continually more and more geared up for the war the importance of the engineering industries and of iron and steel production in the total national income and in the whole economy is thus increasing. The clearing of the field by the ordinary civilian consumer in order to make room for the Service Departments is seen clearly in the transformation taking place in almost all branches of engineering, which constitutes, indeed, the pivot of our economic war effort.

As we can see from Table I, even in peace time the engineering industry in this country is of enormous importance, both as a source of a large part of our national wealth and as a large employer of the labour force. Though it is true that in this war all industries, as well as agriculture, have to play their part and each has to make an important contribution towards the ultimate victory, none of them is so directly connected with it as the iron and steel industry, shipbuilding and the various branches of the engineering trades. A major campaign of the economic warfare is taking place in the shops and shipyards.

Though the latest war figures of production and employment cannot be given for reasons which are obvious, nevertheless the data provided by the Fifth Census of Production furnish enough information to give us a good idea both of the gross and net output as well as of the employment in the engineering, iron and steel industries.

As we can easily read off from Table I the iron and steel and the engineering industries are responsible for a very large slice of the total. Some 26 per cent. of the gross output of all factory trades has been contributed by those two branches of industry. If in turn we take the net output of the iron and steel and engineering indutries, they were responsible in peace time for some 22·5 per cent. of the total net output of all factory and non-factory trades. Those are high figures, indicating that the British economy is highly geared as far as the engineering output is concerned. If, on the other hand, we look at it from the viewpoint of employment, the results are almost identical. Thus the total number of persons employed amounted to some 1,600,000 out of a total of 7,076,000 of all persons employed in the factory and non-factory trades of the United Kingdom, which gives us again a relative share of 22·3 per cent.

From Table II we can find easily the ordinal importance of the various branches of our engineering industry. They are arranged in the order of importance. Thus, though both according to employment and gross and net output, the first place is occupied by either coal mining or the building trade, if we lump all the engineering trades together they will invariably play first fiddle in every respect. The recent armament drive has accentuated this paramount position of the iron, steel and engineering trades still further. At present probably some 30 to 35 per cent. is not an over-estimate.

German Iron and Steel and Engineering

Let us turn now for a moment to our enemy. Table III, which is compiled from official German statistics, gives us a fairly good notion of the relative strength of the iron and steel and metal industries, as well as of engineering trades. The figures are those of employment in the various branches of economic activity in the Reich, covering the territory before the annexation of Austria. For the sake of comparison we have also tabulated the position as it was recorded in 1933 at the bottom of the economic depression in the Reich. We present similar figures for that same year in the United Kingdom, thus providing a basis for comparison.

If we add the total employment in all the first four columns, covering a range of trades from iron and steel production to non-ferrous metals, along with all the engineering industries of Germany (excluding Austria), we shall see that Germany on a peace basis used in those trades the services of some 3,162,000 workers. That was some 24·1 per cent. of the total industry. But if we eliminate the non-ferrous metals and obtain a figure comparable with our previous calculation for the United Kingdom, then the share of the iron and steel and engineering industries in the total of German employment scarcely exceeded 20 per cent., which was lower than in this country. The difference in the share, however, between this country and the Reich proper is not startling. If, however, to the German Reich we now add Austria, Czechoslovakia and all the conquered territories, then the share will rapidly diminish.

While the absolute size of the German engineering industry in many sections is larger than in this country, we may as well remember that its commitments are larger, too. Germany has a much greater need of normal machine replacement than Britain. Moreover, the equipment in Germany, not having been renewed for a number of years, is in bad need of repairs, thus bringing pressure to bear on the engineering trades. This applies to all branches, but to the railway stock most of all. Finally, it would be good to remember that her economy having been adapted to the war years ago, Germany's engineering, iron and steel industry's share in the total was already high and the transition into conditions of war economy could not materially have altered the existing relations. Unfortunately, this is not so fully applicable to the engineering industries in the conquered countries.

Transition

In this country the changes which have taken

TABLE III.—*Importance of the Iron, Steel, Metal and Engineering Trades in the Total Employment of the Reich Before the War, Compared with Similar Figures in Great Britain.*

Trade group.	Germany before the conquest of Austria. Number of persons employed. Males.	Females.	Total.	Total in the year 1933.	Percentage fall during the depression.	United Kingdom. 1933.
	Thousands.	Thousands.	Thousands.	Thousands.		Thousands.
Iron and steel production	506	17	523	268	−48·6	490
Iron and steel and non-ferrous metal manufacture	757	148	905	598	−34·0	
Mechanical engineering, shipbuilding, motor-cycle and aircraft	1210	73	1283	613	−52·2	605
Electrical engineering	334	117	451	254	−43·7	195
Textiles	525	690	1215	857	−29·5	995
Total of all industry and handicraft	10·160	2·938	13·098	9·152	−30·1	Total for all factory and non-factory industries 6·900

Source, German official statistics.

TABLE II.—*Relative Importance of Various Branches of the Engineering Trades in Great Britain (from the Preliminary Report of the Census, 1935, B.T.J., 23.12.37).*

Trade group.	Order of importance according to No. of persons employed. 1935.	1930.	Gross output. 1935.	1930.	Net output. 1935.	1930.
Mechanical and constructional engineering	3	2	2	3	2	3
Motor and cycle (manufacturing and repairing)	6	6	4	6	4	4
Electrical engineering	8	10	11	10	5	7
Iron and steel foundries	16	19	22	26	19	23
Shipbuilding	24	13	26	15	28	17
Coal mines	1	1	3	2	1	1
Building and constructional	2	3	1	1	3	2

TABLE I.—*United Kingdom Iron and Steel and Engineering*

From the Preliminary Report of the Fifth Census of Production.—Comparable Gross Output, Net Output, Number of Persons Employed (Males and Females), Net Output per Person in the Engineering Trades, and Some Other Trades of the United Kingdom.

Trade group.	Gross output.	Net output.	Number of persons employed. Males.	Females.	Total.	Net output per person.
	£000,000.	£000,000.	Thousands.	Thousands.	Thousands.	£
Iron and steel	278	114	434	99	533	215
Engineering, shipbuilding and vehicles	473	240	896	165	1061	227
Textiles	443	156	431	618	1050	149
Total, factory trades	2772	1151	3171	1846	5018	229
Non-factory trades	691	425	2026	31	2058	206
Total, all trades	3464	1576	5198	1878	7076	223

Source, the Fifth Census of Production.

place within the engineering industry itself are very pronounced, as the whole industry was based mainly on peace-time production. Even at the beginning of the war the motor-car industry was still partly occupied with civilian demand and the restriction on the buying of new cars was not imposed until July 20th, 1940. The ban did not extend to motor-cycles, which could be bought freely if the latter were not adapted for carrying goods. Instead of (as many economists have been urging) sales of motor-cars being curtailed by imposing restrictions on the production of civilian cars, which restrictions should have been enforced even before the war, the production only fell when demand was gradually drying up. But that was still the period of the "comfortable" war, when we thought more of maintaining business as usual than of doubling and then trebling our war equipment. Let us hope that phase has passed and remember the words of our Prime Minister that in matters of production drive "we must never be content."

That in engineering industry the period of transition must take time is an indisputable fact. Old orders had to be finished, ships which were half completed launched, before the slate was clean to start. The sad thing was that all this took such a long time that up to Dunkirk we were neck deep in the problems of transition instead of being preoccupied already with the problems of output and supplies. For this many factors are to blame, but again probably the chief mistakes were caused by our general attitude towards this war, which we wanted to organise too "rationally," with the least dislocation of resources and routine, and therefore too slowly. It is a well-known fact that, for instance, the specifications of the various Service Departments were much too detailed and they were being altered much too frequently, with the results that the engineering centres had to face one delay in their output after another. The French proverb that "*Le mieux est l'ennemi du bien*" could not find a more fitting illustration. A comparison with the present state of American armaments (where a Priorities Board at Washington has just been given special powers) forces itself upon the attention. We were then in the "American stage" of production. Here again Dunkirk was for the ordering departments as well as for the industrialists and the trade unions something of a revolution.

In July the Minister of Supply, who is responsible for the placing of an enormous amount of orders, promised in the House of Commons to issue instructions to his subordinate inspectorate staff to reduce the inspection to the minimum. Too frequent changes of designs, which only caused delays, were to be avoided so as to allow a certain amount of standardisation in production. Similar instructions have been issued by the Ministry of Aircraft Production in the direction of not overspecifying and not binding the producers with cumbersome elaborations which result only in slowing down the tempo of production.

All this does not mean, of course, that the standard of our equipment is going to be reduced, but that we are aiming at greater uniformity and at a definitely limited number of types. The problem of quantity is being emphasised perhaps even more than that of quality, which has always been maintained. With the growing strength of our highly mobile armoured divisions, which gave such a good account of themselves in Libya, and of the heavier plated Army Tank Brigades operating with infantry units, the pressure on the motor industry is great. It is satisfactory, therefore, that with the complete closing of the civilian demand the energy of the motor industry in this country can be now fully devoted to the problems of armaments production and to the production of aircraft.

We may remember that for no branch of engineering does the war mean a greater change in the range of their products than for the motor-car industry. This industry constituted the chief pool of skilled labour and of highly specialised equipment, which has lavishly contributed to the new demand for aircraft and Army transport.

TABLE IV.—*Registration of New Cars and Vehicles in Great Britain*

Class of vehicles.	Dec., 1938.	March, 1939.	Dec., 1939.	March, 1940.	June, 1940.
Private cars ...	26,000	39,200	4,700	6,600	—
Motor-cycles ...	2,200	6,400	700	1,700	—
Goods vehicles ...	5,500	7,300	2,800	2,900	—
Agricultural engines	400	885	1,400	2,185	—
Others	900	3,015		1,215	—
Total	35,200	56,800	9,600	14,600	8,000

The summary table above gives us the whole position in a nutshell, showing how the private sales of new motor-cars were dwindling down. Though in February and March, 1940, we observe a fresh spurt of demand for new cars and motor-cycles, caused probably by the anticipated rise in prices or for investment purposes, nevertheless the general trend is clear enough.

AGRICULTURE

In our economic warfare with Germany the progress of British agriculture is of extreme importance. The necessity for ploughing up additional land finds its reflection in the increased demand for agricultural engines and tractors. This gives a fresh impetus to the agricultural engineering industries and to the works manufacturing implements, many of which are being bought by the County Agricultural Committees. The demand in this section is not likely to diminish and the agricultural engineering industries will have to evolve a plan in order to combine their war orders together with the orders coming from British farmers.

EXPORTS

Up till the collapse of France our motor and cycle industry had also the task of supplying our former Ally with a part of her requirements for transport, and on the top of all this was maintained a certain amount of exports. Those exports were encouraged, not for the mere reason of remunerativeness; they also constituted part of our economic warfare. They were designed to provide our economy with the foreign exchanges which are needed for the purchase of raw materials and ready manufactured munitions from foreign countries. And though our foreign assets at the beginning of the war were considerable and we did not need to formulate our policy in the Hitler's slogan "Export or die," nevertheless for a long-drawn war for which we have been preparing, following the policy outlined by our previous Prime Minister, it was essential to keep up our exports in order to diminish the negative balance of trade.

As late as June, 1940, about 4000 British cars were exported, thus contributing approximately £350,000 in foreign exchanges. Exports were going on during the whole first half of the year at a somewhat similar rate. But it was rather unfortunate that from the start exports were not concentrated exclusively on industries which were not so essential from the viewpoint of armaments. It is, however, possible that a large part of our exports consisted of previously manufactured cars in the hands of the dealers. Such exports did not stop war production and probably it would not be a bad scheme if we could enforce a larger export of second-hand cars provided a ready market and the necessary shipping space could be found for them. This would significantly relieve some pressure on the U.S.A. steel production, thus releasing more of its products for us. From the point of view of national economy there is no difference between exporting British-owned diamonds, furs or antique furniture and exporting second-hand cars or unessential machinery. From the point of view of the war effort it is a superior export, in that it does not occupy the productive capacity needed for war.

In normal times the net export balance of machinery and vehicles constituted the largest group, followed next by the textile articles. In war time the composition of our exports must necessarily change. We must give a greater share to other less essential exports. It is therefore remarkable that during the first nine months of the war the value of our exports of iron, steel and engineering products was almost fully maintained. In the period in question it amounted to £25,710,000, which was scarcely £300,000 below the same period in the year before. Naturally, when expressed in volume, exports were reduced, while their average price increased. In proportion this diminution was even less than the fall in total British exports. During the first eleven months of the war total exports were valued at £436,000,000 and were some £50,000,000 below the corresponding figure the year before. Even at present in this more accelerated stage of the war some of the engineering industries are exporting considerable quantities of material. We learn that in the recent trading arrangement entered into between this country and Turkey the export of British locomotives will be prominent, and that negotiations between the local representatives of the United Kingdom Commercial Corporation and the Turkish Government completed in Angora provide for the delivery of a certain number of locomotives and railway wagons to Turkey.

Most of the managers of the large concerns in the engineering trade have been fully aware of the importance of the export offensive. In some cases the Export Credits Guarantee Department had to take over a number of commercial and other risks. At their recent annual meetings a number of firms in the various lines of the engineering industry have been speaking about their effort to maintain or even increase their exports. Thus, for instance, Sir Harold Bowden, at the recent meeting of the Raleigh Cycle Holdings, spoke of the export markets; also Mr. H. F. MacLoughlin, chairman of the Crabtree Electrical Industries, reported that his firms succeeded in considerably extending their exports.

It is only natural that the electrical engineering industries, which are not busy with war work to such an extent as other sections, should do everything in their power to foster exports. In February, 1940, the Government formed the Export Council with the definite purpose of promoting "the greatest volume of export trade which can be achieved under conditions of war." The Export Council works in close contact with the Export Credits Guarantee Department. In the engineering trades any number of export groups has been formed with the participation of the leading trade associations. A whole network of such groups has been created to co-operate together in the sale of their products in overseas markets. In some cases the results achieved were remarkable. Thus, the electrical goods and apparatus manufacturers formed an Export Committee, which was organised in sectional groups with the support of the leading trade associations, including the Electric Lamp Manufacturers' Association, the Meter Manufacturers' Association, the Accumulator Manufacturers' Association, the Cable Makers' Association, the Radio Manufacturers' Association, and the British Radio Valve Manufacturers' Association. As a result of the export drive the global export of electrical goods, such as wireless, cooking and heating apparatus, vacuum cleaners, household appliances, fittings and accessories, primary batteries, meters, and insulators amounted to £7,400,000 in the six months ending May, 1940, compared with £6,370,000 the year before. Cables are an important item of the group, contributing some 30 per cent. of the total.

A certain amount of export has been maintained in the electrical motors and accessories section and in the motor and control gear sections. Apart from important orders executed for the Empire countries, such as motors powered 20,000 H.P. for rolling mills to drive a reversing blooming mill and high rail mills in Australia and Bengal, a certain amount of export went to China and Portugal, which bought winder motors. Smaller motors went to Spain for piercers and pilger mills. The copper mines in Turkey installed some 5000 H.P. of British motors. Considerable activity was maintained in the motor traction section, where part of the electrification of the Brazilian Central Railway was completed. Tramcars were delivered to the Argentine as well as a number of trolleybuses.

It is, of course, impossible within the limited scope of this article to give even an approximate account of the effect of our export drive, which, with the extension of the war, had to be limited to a smaller number of countries. It is, however, certain that with time the composition of our exports is gradually changing and that with the fulfilment of orders the non-essential sections of trades will have to extend relatively to all others. It will be impossible and it would also be unwise to foster exports in all those sections which even potentially could be used for armaments. This is why our exports in the shipbuilding, machinery, vehicles and other sections cannot be maintained while they are busy with armaments. Until America is fully prepared to help us financially we must find foreign resources from exports and sales of assets. In the economic warfare with the Axis Powers the engineering industries, whenever feasible, must be used directly for armaments. In other sections everything is to be said for limiting domestic consumption and for exporting, assuming the labour power and productive capacity is not needed for war work, effectively or potentially.

MAN POWER

This brings us to the question of man power and productive capacity, which, together with that of supplies of materials, is the crux of the whole economic effort in this struggle against the Axis. The question of capacity has two main aspects. The first is the best use of the existing machines in the country, together with the best employment of

machine toools ; the second is the best distribution of production, both geographically as well from the point of view of the size of the enterprise. It was a serious mistake at the beginning of the war that so little use was made of the spreading of orders and sub-contracting. Concentration of production had some advantages from the point of view of the ordering departments' output controllers, and it suited the interests of the larger members of the engineering industry. To-day, in view of events, there is no doubt that a further use will have to be made of not only sub-contracting, but duplicating a large number of small orders, which *per toto* can give a considerable result. Various schemes for area organisation, including local productive capacity exchanges, have been discussed, and in some cases area organisations are being gradually set up for the best employment of the specialised equipment. As yet not much use has been made of these organisations and too much competition for qualified labour and machinery has been taking place. The Government is aware of this danger, and Mr. Bevin, Minister of Labour, referred to it in one of his recent speeches. With almost all sections of the engineering industry working to capacity it is impossible to adjust the existing demands for labour, machinery and raw

TABLE V.—*Average Weekly Earnings in Metal, Engineering and Shipbuilding Industries in October*, 1938, *and July*, 1940 (*M. of L. Gazette*).

Industry.	Average of all workers returned (including men, boys, women and girls).		
	Last week of Oct., 1938	Week ended July 20th, 1940.	Percentage rise.
	s. d.	s. d.	
Pig iron (blast-furnaces)	79 11	93 10	17·4
Iron puddling, steel smelting, &c.	73 2	96 10	32·3
Non-ferrous metal	63 0	86 8	37·3
Tin-plate	71 5	75 6	5·7
Iron and steel tubes	63 4	87 0	37·4
Wire, wire netting*	55 3	76 0	37·6
Engineering :			
General	60 5	85 4	45·3
Electrical	50 10	72 5	42·5
Marine	61 9	84 0	36·0
Constructional	62 5	82 8	32·4
Motor vehicles, cycles, aircraft	70 8	106 5	50·6
Shipbuilding	59 11	90 8	51·3
Railway carriage, &c.	62 0	80 10	30·4
Electric cable, apparatus	50 1	68 4	36·4
Hand tools, cutlery, &c.	45 1	64 2	42·3
Bolts, nuts, screws	42 4	58 3	37·6
Brass and yellow metal goods	49 2	62 4	26·8
Heating and ventilating	67 10	80 10	19·2
Watch, clock, jewellery	48 1	55 10	16·1
Other metal industries	49 4	67 1	36·0
Total metal, engineering and shipbuilding	59 5	85 1	43·2

* Average for all workers employed in firms being members of Engineering and Allied Employers' National Federation, as in July, 1940, 96s. 7d.; while for other workers 71s. 8d.

materials by competition. The economists are quite aware of the fact that where the supply is not sufficient to meet the demand at the existing prices, the latter must rise, and when on the top

TABLE VI.—*Average Weekly Earnings in Some Industries in October*, 1938, *and July*, 1940 (*Official Figures, M. of L. Gazette*).

Group of industries.	Average of all workers returned (including men, boys, women and girls).		
	Last week of Oct., 1938	Week ended July 20th, 1940.	Percentage rise.
	s. d.	s. d.	
Metal, engineering, shipbuilding	59 5	85 1	43·2
Textile	38 3	48 10	29·2
Clothing	35 7	40 2	12·9
Food, drink, tobacco	46 10	53 8	14·5
Woodworking	52 4	61 5	17·4
Paper, printing, &c.	55 5	57 1	3·0
Building	61 3	80 7	31·6

of that the demand is absolutely inelastic, as in the case of armament goods, where it must keep on increasing, this will lead to a very large rise in prices. In order to avoid it a comprehensive system of rationing the labour and machine supply must be evolved. A case could be made that this is the only way open for reducing the civilian demand for materials and that if wages cannot be stopped otherwise from rising inflation is the only course. Socially it is a well-known fact that inflation brings hardship to the poor and a case could be made on very strong moral grounds that those workers in key positions and whose claims cannot be refused should proceed circumspectly with their demands, having in mind the hardship which a rise in prices imposes on other classes of workers not in such strong position as themselves.

Since May the number of shifts has increased and the number of hours worked by any skilled and semi-skilled operative in the engineering industry has risen. In some cases this great acceleration is endangering the endurance and health of the workers. For this reason efforts must be redoubled to increase the supply of skilled and semi-skilled relief labour. The technical colleges and training centres have an enormous work still to perform in order greatly to increase the "cadres" of labour for munitions industries. Women have a decisive part to play and the scale of the present training of women is ludicrously small compared to what will be required of them in a period not longer than some ten months hence.

WAGES

This demand for engineering labour is best reflected in the rise in average weekly earnings, relatively larger than in other trades, which is illustrated by Tables V and VI, both drawn from official statistics.

At present we close 1940 just as we started it, viz., with a demand for higher wages. The claim is being considered by the National Arbitration Tribunal. The claim of the Amalgamated Engineering Union, the largest engineers' organisation, is for an additional 3d. an hour to the present wage rates. An analogous demand is made simultaneously by the National Union of Foundry Workers, while the other engineering organisations in the shipbuilding trade claim a flat piece rate of 10s. a week. It is fortunate that the representatives of both negotiating parties are fully aware of their responsibilities, and one can anticipate that, in addition to their own, they will fully consider the national interests.

As we see, for the whole group of metal, engineering and shipbuilding the rise up till July, 1940, was 43·2 per cent.

Table VI will give us a comparison of the group total with other larger groups of industries.

While these figures represent the average earnings for both qualified and unskilled labour, including boys, women and girls, the average for all men is much higher and amounted in July, 1940, to £5 0s. 3d. per week, which represented an increase of 36·3 per cent., compared with our standard week of October, 1938, last available. If we take the weekly earnings of the skilled workers we obtain a large average, though the percentage increase is not so striking. The totals, however, are much higher.

According to the data presented by Sir Alexander Ramsay between October, 1939, and October, 1940, wages and weekly earnings increased as shown in Table VII.

Our man power and machine tools must be used rationally. This includes at least two aspects of the problem. First, they should always be directed towards work of national importance ; and secondly, they should be used extremely economically. There are signs that the first problem is gradually being realised. The various restrictions on the use of machine tools and the sale of second-hand machine tools, as well as the compulsory registration of engineers, chemists, physicists, &c., instituted in August, is the best move in this

TABLE VII.—*Increase of Earnings and Hours in Engineering Industries.*

Workers.	Increase in weekly earnings.	Increase in hours per week.
	s. d.	Hr. Min.
Skilled	+28 0	5 36
Semi-skilled	+24 1½	5 36
Unskilled	+16 4	4 30

direction. The purpose of the Industrial Registration Order (S.R. and O., 1940, No. 1459) is to secure a register of names of all engineering skill and semi-skill which is not yet wholly occupied in essential work in which there is already or is likely to be soon a shortage of qualified labour. The list embraces a wide number of occupations from finishers, coppersmiths, core makers, die casters to tool setters, turners, welders (gas and electric). Another measure intended for the transfer of labour towards armaments production is the use of "de-reservation," providing that a certain category of workers shall no longer remain in the reserved occupation unless they can find employment in essential industries. Only recently the age reservation for electricians has been raised to thirty as from January 8th, 1941 (in the case of fault finders and testers from thirty to thirty-five), unless they are employed in work of national importance. Similar measures for the best use of machine tools tend to direct new and second-hand gauges, jigs, fixtures, capstans, turrets, boring and other machines towards direct war work.

There is, however, yet not enough understanding that both our skilled man power and the specialised equipment should be used with the utmost economy and that our patriotic workers cannot go on for a long time without holidays and without proper rest. The problem of relieving them by diluting on a large scale and by producing new cadres of workers (many of whom must be women) is therefore the more urgent.

All this effort must be undertaken in order to keep pace and to out-distance the very large enemy engineering industry, which day and night is working to the point of breaking preparing for Germany's next *Blitzkrieg*. Only at the moment when we shall be able to secure for ourselves an endless stream of supplies from America and from all the corners of the British Empire will our engineering industry be able to take the first rest. But the best policy is not to expect miracles ; the trouble with them is that they never happen when they are most wanted.

Civil Engineering in 1940

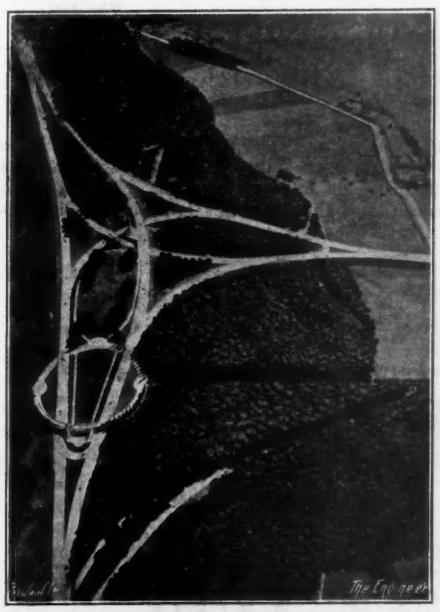
No. I

IN the spring of 1940 the war blazed up into activity with a suddenness that was all the more startling for its contrast with the unreal lassitude of the preceding winter months. Repercussions were felt in every corner of this country. The more obvious sign of a change of heart was the fall of a Government and the rise of a new one which, with great vigour, set about the acceleration of the tempo of armaments production. But the effects were, in fact, so widespread that scarcely a single business or individual remained unaffected. We ourselves, had not the reduction of our staff in the interests of war work already made it known to us, would have been made aware of the change, not only by a restriction upon paper supplies, but also by the more strict application of the censorship. The enemy, indeed, had forced his way so close to the gates of this country that the publication of various items of information that formerly could only have been of purely hypothetical use to the Nazis had become imminently dangerous. Thus this article has been compiled under difficulties, and if, in making a review of civil engineering in 1940, we may appear to have drawn unduly heavily upon the works of foreign engineers and particularly those being carried out in America, we must beg our readers' indulgence. In the not very distant future Hitler's armies will be driven back whence they came, and we shall be able to give that prominence to the work now being done by British engineers that it so strongly deserves. In a Supplement that accompanies this issue we reproduce some photographs of works that were in progress or were completed during 1940. Descriptions of those works will be found in this article or its continuation in next week's issue. Several other engineering schemes will also be described. As consulting engineers in this country are very largely involved in works which have a more or less direct connection with the prosecution of the war, little can be said about their work. It may be remarked in one instance, however, that the system of tunnels to be constructed in connection with the London tube railways for use as shelters is being constructed to the designs and under the direction of Messrs. Mott, Hay and Anderson at a cost of about £1,500,000.

Road and Rail

Just before the war broke out in September, 1939, there seemed to be a justifiable hope that under the railways, "Square Deal" proposals agreed with road interests the long-lived road-rail controversy would at last be stilled. But on the outbreak of hostilities the Government assumed differing degrees of control over the various forms of transport. As a consequence of the agreement it then arranged with the railway companies,

the road-rail controversy shows signs of reawakening vigour. For during the year under review road transport organisations began to express themselves, with increasing emphasis, dissatisfied. It was contended that an undue amount of traffic was being assigned to be carried by the railways with the consequence that the system had become overloaded and delays were prevalent, and it was also complained that the cessation of the manufacture of vehicles for home use, and the rate at which drivers and skilled mechanics were being drawn into the armed forces would make it difficult, if not impossible, for the road transport industry to put a sufficient number of vehicles on the roads if a call was made upon it in an emergency. These criticisms were voiced the more loudly when the railway companies, by virtue of the agreement made with the Government, were able repeatedly to increase their charges in order to meet rising costs, an action which was the subject for criticism and objection from other quarters as well. Further dissatisfaction was created by the rejection by the Ministry of the Report on the War-time Co-ordination of Goods Transport received from the Transport Advisory Council. The Council had been called into consultation by the Minister in February, and the report, issued in July, suggested a means by which the division of traffic between the four available branches of transport—road, rail, canal, and coastwise shipping—might be made more equitable and efficient. The report, together with that of the Road Goods Transport Special Emergency Committee set up in May under the chairmanship of Mr. S. F. Garcke, which embodied similar conclusions, was rejected by the Minister on the ground that, owing to the emergency conditions ruling after the defeat of France, the time was not propitious for the proposed reorganisation. With the appointment, however, towards the end of the year, of Lieut.-Colonel Moore-Brabazon to be Minister of Transport, the road transport industry was able to hope for a more sympathetic consideration of its views. For the new Minister, who has had experience as Parliamentary Secretary to the Minister from 1923 to 1924, and from 1924 to 1927, has for long been one of the leaders of the parliamentary "Road Group."



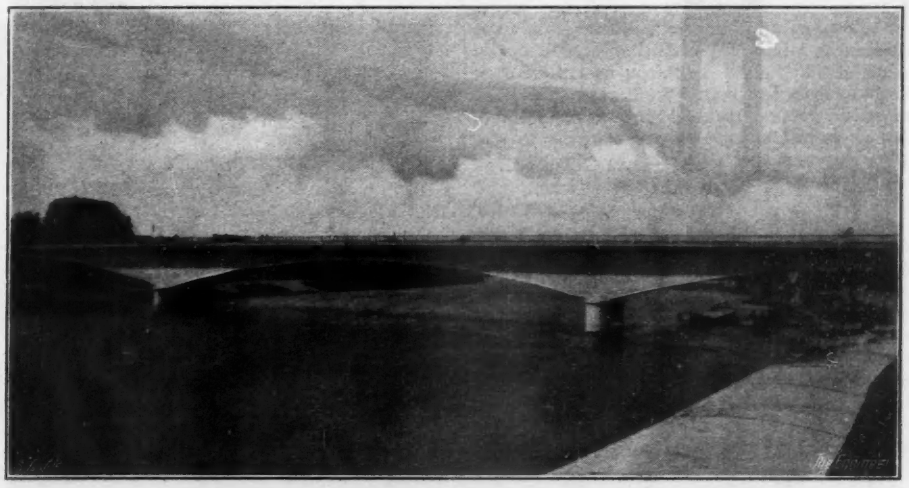
MODEL OF THE ROCQUENCOURT "TRIANGLE"

Roads and Bridges

As far as roads and bridges were concerned, the year 1940 was not a notable one, for no important work of this character was either started or brought to a conclusion—except perhaps in America. Nevertheless, mention should be made of the continuance of the work of constructing the great Howrah bridge across the Hooghly River at Calcutta, which when complete will have the third longest cantilever span in the world, 1500ft. long. It is to carry a roadway no less than 71ft. wide and two 15ft. pathways. Details of this bridge have been repeatedly mentioned in this journal, and we need go no further than to say that the main span will be made up of a suspended span 564ft. long and two cantilever arms, each 468ft. long. The anchor arms will be 325ft. in length and the two towers will reach a height of 270ft. above roadway level. Messrs. Rendel, Palmer and Tritton, of Westminster, are the engineers for this work, and the Cleveland Bridge and Engineering Company, Ltd., the main contractors. During the year 1939 the foundations for the main piers were completed and the erection of the steelwork was continued during 1940.

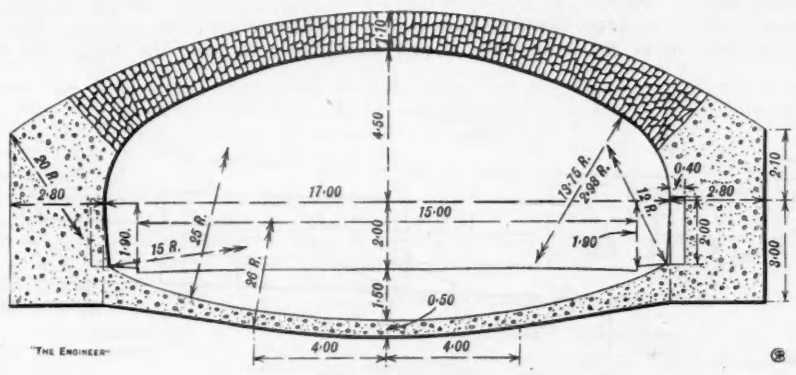
In this country, despite delays resulting from war conditions, work was continued on Waterloo bridge across the Thames in London, under the direction of Messrs. Rendel, Palmer and Tritton, in conjunction with Mr. T. Peirson Frank, Engineer to the London County Council. This bridge, the erection of which has been entrusted to Peter Lind, Ltd., will consist of three central reinforced concrete spans, 252·7ft. long, and two shoreward spans, 242·7ft. long, and will be wide enough to carry six lines of traffic. Its design has been several times mentioned in our pages.

In France, during the early part of the year, work was being continued on a road scheme of considerable importance. Whether any progress was made after the German occupation we have no means of knowing. The scheme concerned, known as the Auto Route de l'Ouest, was for an improved outlet from Paris and was originally approved by the Government in May, 1935. It provided for the reconstruction of an old bridge at St. Cloud and the construction thence of a new road to Rocquencourt, with a northern extension to join Route Nationale No. 190 west of St. Germain-en-Laye, and a southern extension to meet Route Nationale No. 10 west of Versailles. The work was begun in July, 1936. The bridge at St. Cloud was being reconstructed as an electrically welded steel plate girder structure and was sufficiently near completion in March last to be opened, though not finished, in order to improve access to the country west of Paris. In order to avoid the narrow streets of St. Cloud, a tunnel was driven into the limestone hillside under St. Cloud park. The tunnel is 2729ft. long and 55ft. 9in. wide. Its section is shown in an accompanying engraving. From the exit from the tunnel to Rocquencourt the road was constructed with a total width at formation level of 98ft. 5in., within which were included two carriageways, 29ft. 6in. wide each. There were no crossings on the level, all side roads being provided with under or overbridges. One of the engravings on this page illustrates a model of the Rocquencourt "triangle" where the road bifurcates into its northern and southern extensions.

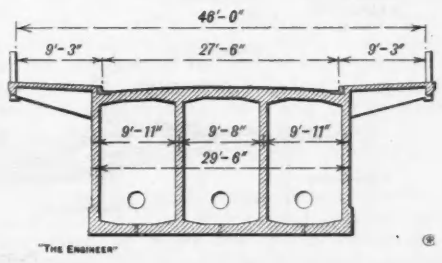


VILLENEUVE ST. GEORGES BRIDGE OVER THE SEINE

A new bridge in France, which, it is much to be feared, may have been damaged or destroyed last spring, is illustrated in one of the engravings. It is the Villeneuve St. Georges bridge across the Seine, which was completed early in the year and which carries, or carried, a 27ft. 6in. roadway and two 9ft. 3in. footpaths. The central part of this bridge, 448ft. long, is a monolithic ribbed structure, which projects 96ft. 6in. over the river piers towards each bank. Independent ribbed suspended portions connect it to the abutments. The deck is carried on the left bank river pier by a concrete hinge and on the right bank pier by a pendulum bearing. The footways are cantilevered out over the sides. A reinforced concrete raft carried by fifty-three Rodio pressure piles forms the foundation for each pier. A section through the ribbed superstructure is reproduced on this page.



SECTION THROUGH TUNNEL UNDER ST. CLOUD PARK

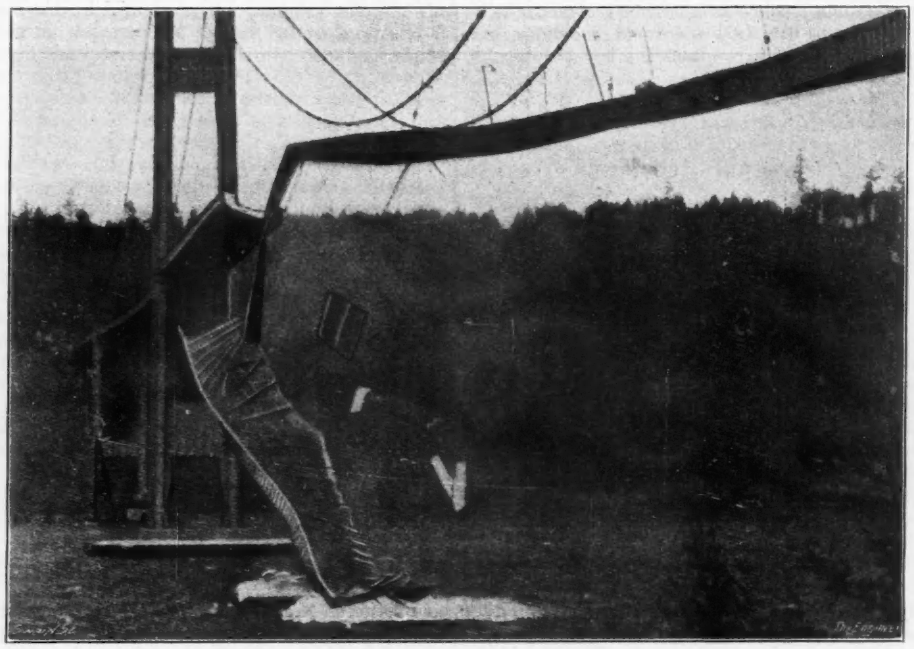


SECTION OF VILLENEUVE ST. GEORGES BRIDGE

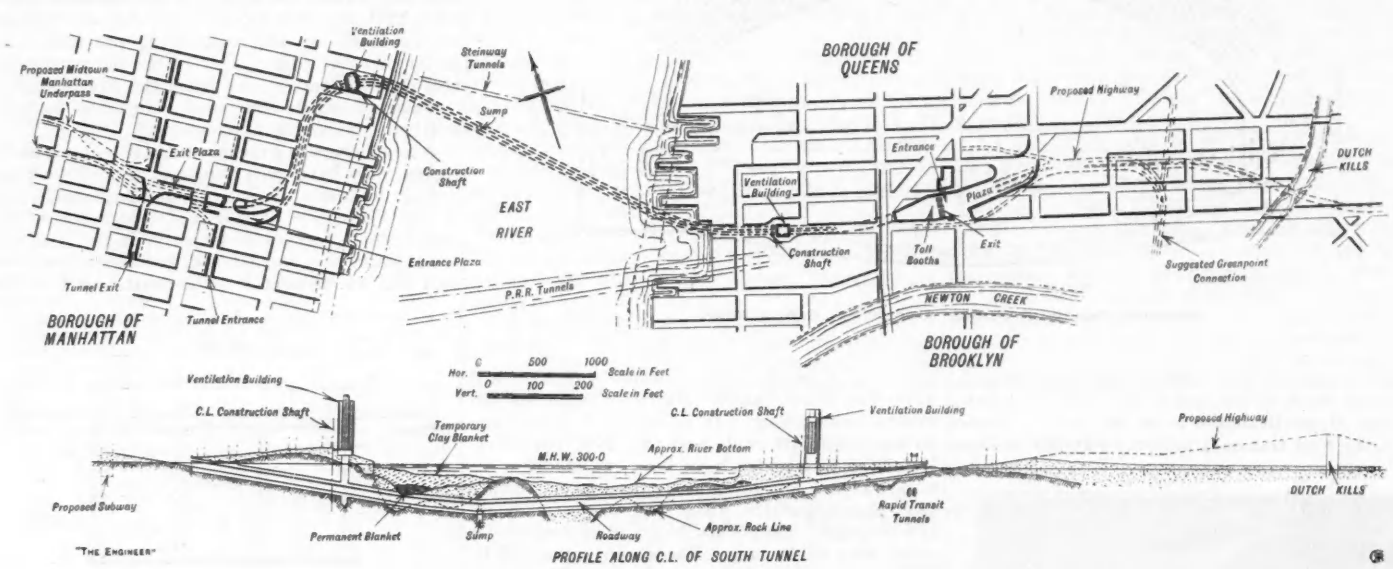
From Spain the news was received during the year that the Esla viaduct, described in THE ENGINEER in August, 1938, was at last opened in July, 1940. This railway bridge across the River Esla, on the line between Zamorra and Corunna, it will be remembered, is claimed to be the longest reinforced concrete arch in existence. It has a span of 672ft., a width of 29ft. 6in. at the springing, and 26ft. at the crown, and thicknesses at the same places of 18ft. and 14ft. 10in., respectively. Owing to the Spanish civil war work upon it was much delayed. Timber centering which was placed in position for the construction of the arch, suffered considerable damage from wind and rain, and eventually new centering of steel lattice trusses was erected to replace it. That work was completed

by April and thereafter work proceeded very rapidly.

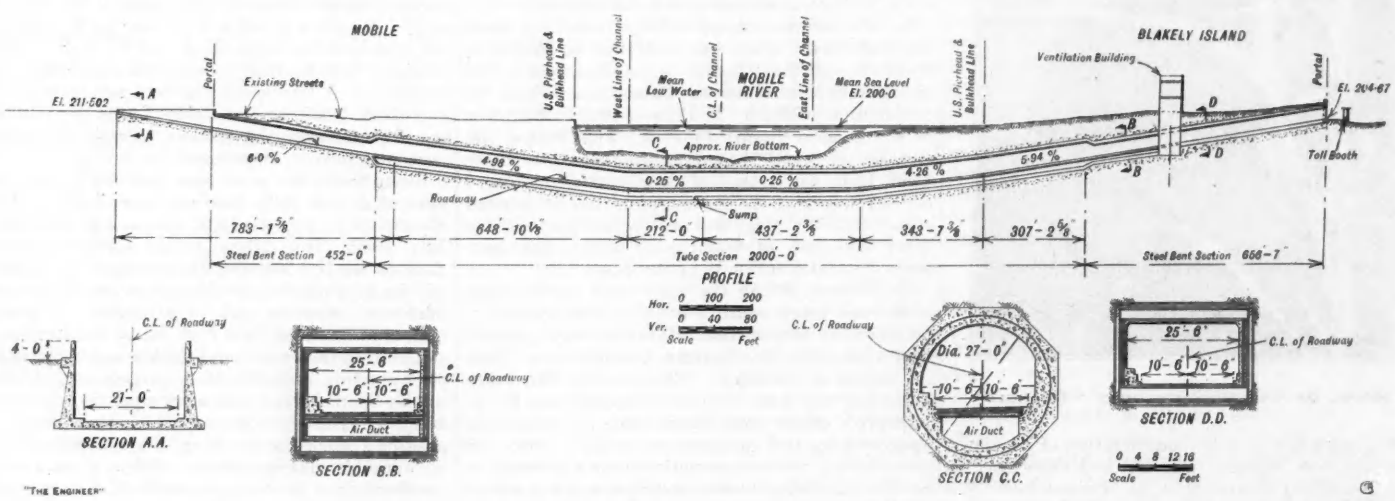
We cannot bring this account of Roads and Bridges in 1940 to a conclusion without some reference to the Tacoma suspension bridge in Puget Sound, Washington, which, only completed in July of last year, on November 7th collapsed into the waters of the Sound. The bridge, of the suspension type, with a central span of 2800ft. and a total length of 5000ft., was notable, not only as having the third longest suspension span in the world, but also on account of its very high span to width ratio at 72. It carried a roadway 26ft. wide and two 4ft. 9in. footpaths. It was designed and constructed by Lacey V. Murray, Chief Engineer to the Washington Toll Bridge Authority, and Director of Highways, advised by a consulting Board. We need not refer in detail to the design, since a description of the bridge was published in our issue of November 15th, 1940, only a few weeks ago. For some time before the failure—indeed, ever since the bridge had been opened to traffic—it had been noted that under strong winds the deck of the bridge was deflected by vertical travelling waves to the extent of some 50in. amplitude, and researches had been undertaken with a model to discover means of controlling this motion. On the occasion of the collapse of the bridge the wave motion on the two sides of the bridge became out of step. The following is the eyewitness account of Professor E. B. Farquharson, who was conducting researches on the site and with a magnetic model in the laboratory into the behaviour of the bridge:—"I was the only person on the bridge when it collapsed, endeavouring to get a motion picture of the unusual way the bridge was acting for my official records. When I arrived about 9.45 a.m., the bridge was moving in a normal way, in the familiar rippling motion we were studying and seeking to correct. About half an hour later it started a lateral twisting motion in addition to its vertical waves. It had never done that before. There was considerable noise of stress and strain. As the motion increased in severity, lamp posts were jerked back and forth in a side motion and at least six snapped off while I was on the bridge. A few minutes later I saw a side girder bulge out on the Gig Harbour side, due to a failure, but though the bridge was buckling up at an angle of 45 deg. the concrete did not break up. Even then, I thought the bridge would be able to fight it out. Looking toward the Gig Harbour end, I saw the suspenders snap off and a whole section of the bridge cave in. The main cable over that part of the bridge, freed of its weight, tightened like a bow string, flinging the suspenders into the air like so many fish lines. I realised the rest of the main span of the bridge was going, so I started for the Tacoma end. Behind me the rest of the bridge plunged into the Sound. By that time I was between the tower on the Tacoma side and the Tacoma shore. I thought I was out of danger, but suddenly the bridge dropped from under me. I fell and broke one of my cameras. I got up and started, only to have the bridge fall out from under me again. The part of the bridge I was on had dropped fully 30ft., due to the sudden shift of weight in the main cable. It was one of those things that couldn't happen once in 1000



COLLAPSE OF TACOMA BRIDGE, PUGET SOUND



PLAN AND PROFILE OF QUEENS MIDTOWN TUNNEL, NEW YORK

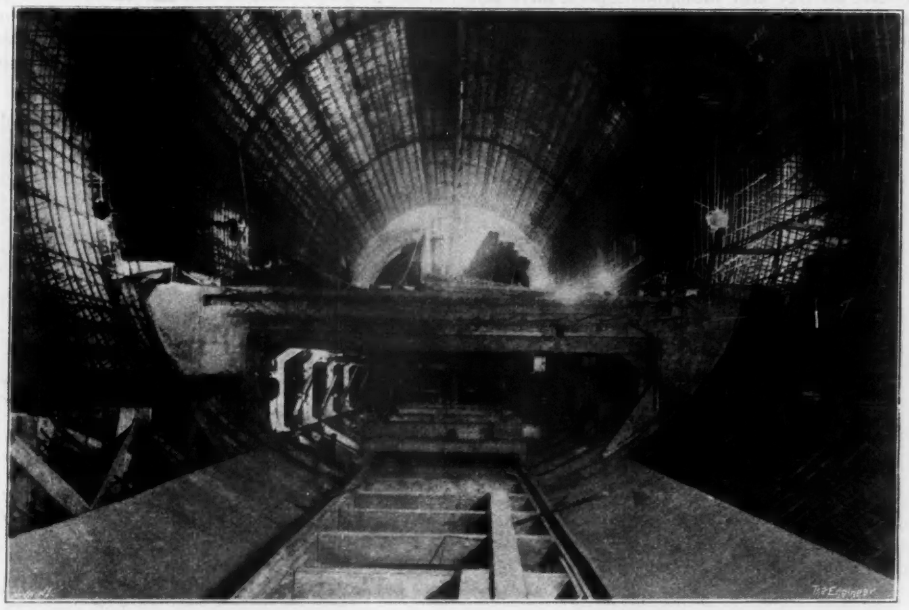


PROFILE AND SECTIONS OF VEHICULAR TUNNEL AT MOBILE, ALABAMA

years, a combination of conditions that no one anticipated."

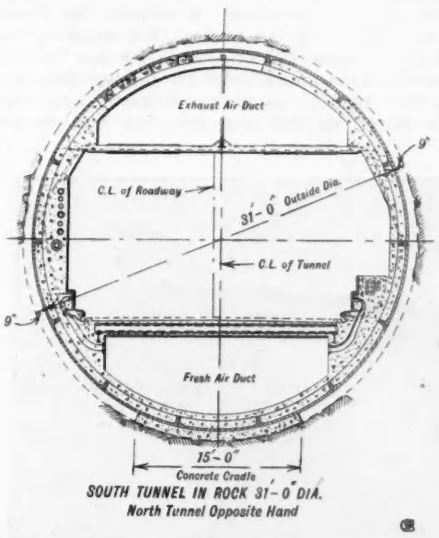
Tunnels

To find examples of tunnels under construction or completed in 1940 it is necessary to go to America. It is true that there is a partially completed tunnel in this country—that between Dartford and Purfleet, under the Thames near London. But work upon that scheme was suspended upon the outbreak of war. In Holland, too, there was approaching completion a road tunnel under the Meuse at Rotterdam. It was described in THE ENGINEER on October 6th, 1939. No information is, of course, available regarding the state of that work.



CONSTRUCTION OF TUNNEL AT MOBILE, ALABAMA

In America another tunnel was under construction at New York. It is known as the Queens Midtown tunnel, and passes under the East River and it is being driven under the control of the New York City Tunnel Authority at an estimated cost of 58,365,000 dollars. When finished it will consist of twin tubes, each carrying a one-way 21ft. wide road and the clear headroom is to be 13ft. 5in. Lengths between portals are 6272ft. and 6414ft. for east and west tubes respectively, and the following table gives in concise form the types of construction adopted :—



SOUTH TUNNEL IN ROCK 31'-0" DIA.
North Tunnel Opposite Hand

TYPICAL SECTION OF QUEENS MIDTOWN TUNNEL

Construction of Queens Midtown Tunnel

	Approximate lengths. South tunnel. Feet.	North tunnel. Feet.
Steel bent and concrete (Manhattan)..	390	384
Rock tunnel: 32ft. 10in. diameter, structural steel lining (Manhattan)...	958	1134
Shaft construction (Manhattan)... ...	65	65
Shield-driven tunnel, 31ft. diameter cast iron lining	3767	3751
Shaft construction (Queens)...	35	35
Steel bent and concrete (Queens)... ...	1057	1045
Total	6272	6414

Maximum gradients of 3·5 per cent. up and 4 per cent. down have been adopted, and the minimum curve has a radius of 450ft. Accompanying drawings show a plan and profile and a typical section of the tunnels. There are to be two ventilation buildings, one on each side of the river, and the ventilating fans will be capable of delivering a maximum of 2,826,000 cubic feet of fresh air a minute into the tunnels, equivalent to forty-two complete changes of air per hour.

In Alabama another tunnel is under construction. It is at Mobile, a town at the mouth of the Mobile River, and it extends for 3388·5ft. from Mobile itself to Blakely Island, whence a road leads across Cochrane Causeway to the mainland. The work of construction can be divided into several sections. At the Mobile end there is an open-cut ramp, 280ft. long, followed by a cut-and-cover rectangular portion, 452ft. long of steel bent construction. The under-river portion of the tunnel is made up of seven interconnected sections, five 298ft. long and two 255ft., and at the Blakely Island end there is another rectangular cut-and-cover steel bent section, 656·5ft. long. The roadway is 21ft. wide. The seven under-river sections were sunk into position. Each is made up of a built-up welded inner cylindrical steel tube, 30ft. in diameter, of $\frac{3}{8}$in. plate, surrounded by an outer tube of octagonal cross section of $\frac{1}{4}$in. plate, with a least diameter of 34ft. The two cylinders are tied together by steel ribs at 12ft. centres. Concrete fills the space between them and the interior of the inner cylinder is also lined with concrete. The contractors for the work are the Arundel Corporation, of Baltimore. The Alabama Drydock and Shipbuilding Company constructed the underwater sections, which were towed to Blakely Island, where the greater part of the concrete was placed. An engraving in the Supplement shows that work in progress. While still retaining a small reserve of buoyancy, each section was towed out into the river and suspended over the position it was to occupy by chain hoists secured to a gallows frame. The final concrete was then placed, removing all buoyancy, so that the section could be lowered into the previously prepared trench. This tunnel, when complete, is to be ventilated solely by suction fans. No air will be forced directly into the tunnel.

In South America the Transandine Railway tunnel, on the Transandine Railway, between Argentina and Chile, originally constructed in 1910 to the designs of Livesay and Henderson, of London, was converted during the year for use as a road. Provision has been made for closing off road traffic when the infrequent trains pass through. The tunnel is at an elevation of 10,521ft. and has a diameter of 16ft. 5in. Special roads had to be constructed to give access to the two portals.

(To be continued)

Aeronautics in 1940

A YEAR ago, after four months of war, it became possible to assert with considerable confidence that if we fell short of the enemy in the number of first-line aircraft at our disposal, British aeroplane types had, machine for machine, demonstrated their superiority over those of the Germans. Twelve months' additional experience has more than confirmed that early conclusion. We still lag behind the enemy in numerical strength, but the quality of our aircraft—and of our pilots—has been put to repeated and searching tests and in no way has it been found wanting. Again and again British squadrons have routed the enemy at great odds in numbers. Repeatedly our aircraft have returned from aerial combats and from raids damaged to an amazing degree, but still capable of flying and landing at their bases. Much, very much, must be attributed to the superlative courage and skill of our airmen, but it is self-evident that all the heroism in the world could not have achieved what they have done without aircraft of outstanding design and construction.

In September, 1939, this country was fortunate in having several types of aircraft, possessing notably high performance characteristics and a number of exceptional features, which had fairly recently reached the stage of quantity production. Chief among these aircraft were the Vickers-Supermarine "Spitfire" and the Hawker "Hurricane," eight-gun single-seater fighters, the Vickers "Wellington" long-range bomber, and the Bristol "Blenheim" bomber-fighter. Chance had played its part in providing us with these designs just when they were needed. The "Spitfire"—and, to a slightly less extent perhaps, the "Hurricane"—were the direct outcome of the work done in previous years in developing the series of seaplanes with which this country finally won outright the Schneider Trophy. It will be recalled that the contest for this trophy, in its last phase, was frowned upon by the Government of the day and that our success in winning it and all the lessons learnt from the efforts made to secure victory would not have been ours but for the generosity of the late Lady Houston. Private enterprise and encouragement also played a part in the evolution of the prototype of the "Blenheim." As for the "Wellington," with its unique "geodetic" system of construction, it can be truthfully asserted that its existence in numbers at the outbreak of the war is to be ascribed to the courage with which Vickers adopted Mr. Wallis's revolutionary ideas and the skill with which they quickly adapted their works for the quantity production of aircraft embodying the new principle.

Nevertheless, while chance played a fortunate part in the position with respect to aeronautical equipment in which we found ourselves in September, 1939, it would be foolish and ungrateful to ignore the deliberate part played by the Air Ministry. The approaching storm was long heralded. The new types of aircraft were not as yet fully developed and were not ready for mass production, either in the works of their designers or in the "shadow factories" which were being organised. It would have been an easy solution to standardise the existing less efficient designs of aircraft and to prepare the way for their production in immense numbers on the outbreak of war. Some people have criticised the Ministry for choosing the advanced qualities of the new designs in preference to the increased numbers which would have been forthcoming had it adhered to the established types. Where, one may wonder, would we now be if the Ministry had acted otherwise than it did? We can obtain some inkling of the answer to that question by noting the experience of the enemy. The Germans elected to obtain numerical strength rather than the strength which comes from quality. They standardised their production for war at least two years before we did. Those two years were marked by vital developments in aircraft production. They witnessed the advent, not only of the new British designs to which we have referred, but of the power-operated gun turret and other devices which have fully proved their worth in battle during the past twelve months. The Germans

missed most of these developments and are still struggling to catch up with them.

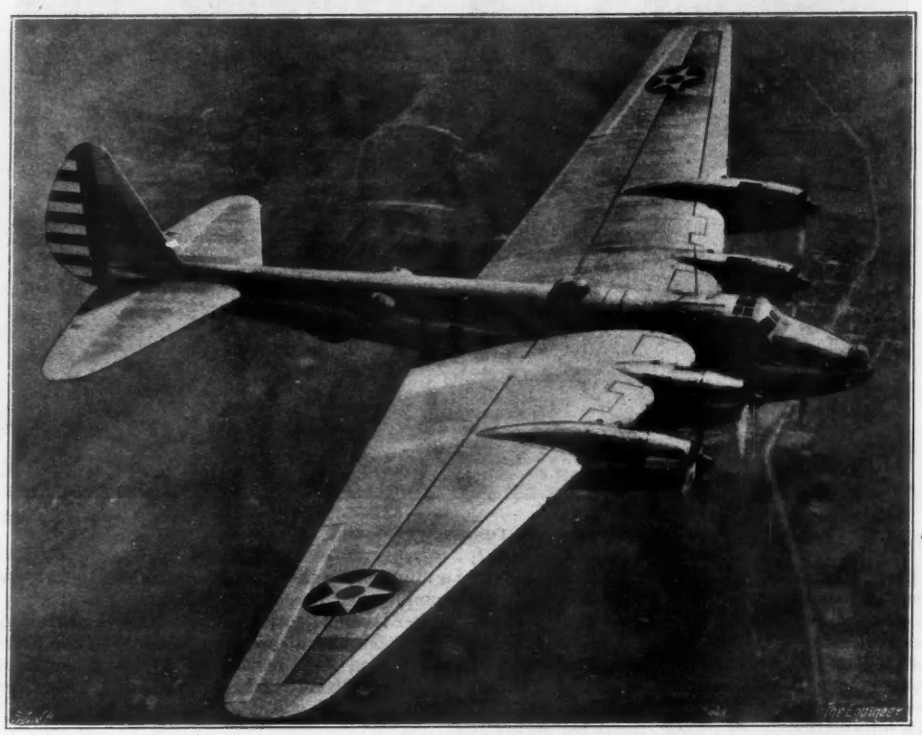
A specific illustration of the above remarks can be given. The most notable, or notorious, type of German "Stuka," or dive bomber, is the Junkers 87 monoplane. It achieved considerable success against the Polish and French forces, but in both cases these forces lacked anti-aircraft defences and training against dive-bombing attack. The moral effect of these "Stukas" was very great, but their success was quite disproportionate to their intrinsic qualities. Actually, the Ju.87 design is about eight years old. Not until after the capitulation of France did it find itself pitted against modern air and ground defences on an adequate scale. When, during August and September, the Germans employed Ju.87s against our shores and shipping, more than half those engaged were destroyed, chiefly by our "Spitfires" and "Hurricanes." While it is not permissible to say what improvements we have made in the dive-bombers with which we started the war—such as the Blackburn "Skua" and the Hawker "Henley"—it can be stated that a recent American desgin, the Douglas D B 7, of which examples will no doubt be available to us, has a top speed of about 330 m.p.h. That speed is not far short of that possessed by the early patterns of "Spitfire" and "Hurricane." In contrast with it the Ju. 87 has a top speed of only about 240 m.p.h.

From these facts we may infer something of the penalty which the enemy has had to pay for his too hasty decision to standardise his aircraft production. That decision might have been a profitable one to him had the war started a year earlier than it did. As it was, the Munich conference gave us a year's breathing time and enabled us to win the race for quality as against numbers. To-day we are bent on making up the disparity in numbers, and with the aid of the United States and Canada we are in a fair way towards achieving that end. We are not, however, allowing the enemy to overtake the lead in quality which we possessed at the beginning of the war. New designs, such as the Bristol "Beaufort" bomber, the Boulton-Paul "Defiant" fighter-bomber, and the Fairey "Fulmar"—the Fleet Air Arm's counterpart to the "Spitfire"—have already been brought into service and others of which no mention may be made are on the way.

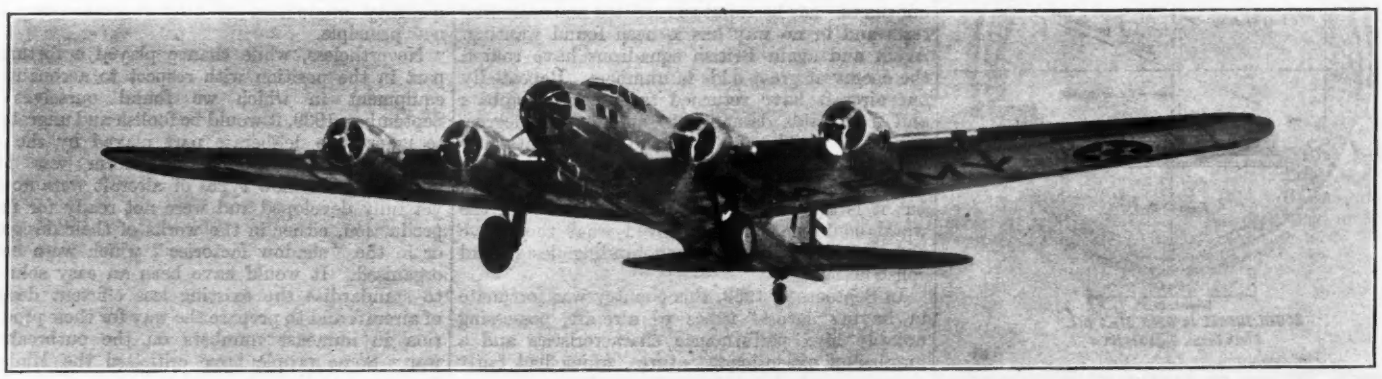
Different opinions have been expressed concerning the quality of the workmanship and materials revealed by the German aircraft which have fallen into our hands. Some assert that the Messerschmitt 109 fighter is an inferior product, both in general design and in construction. It has no bulletproof windscreen and no armouring for the pilot. The fuel tank is badly positioned relatively to the centre of gravity and is very vulnerable. Its armament and equipment, it is said, are so inferior that given two pilots of equal skill, the Messerschmitt must be shot down every time by a "Spitfire" or "Hurricane." On the other hand, equally competent investigators have found no sign of *ersatz* material in any German aircraft which they have examined. They praise particularly the design and quality of the enemy's self-sealing petrol tank and his engines. It has been asserted, too, by some, that many German aircraft are poorly equipped with flying and navigational instruments, while others have found no deficiency whatsoever in these respects. It seems probable that these contrasting opinions may both be well founded and that there is a very considerable variation in the quality and construction of German aircraft. Doubtlessly, opinions based on the examination of aircraft constructed before the war or during its early and less intense months are likely to be different from those derived from the inspection of more recently constructed machines.

If there is thus some difference of view concerning the quality of German aircraft there is none concerning that of British machines. As we have already said, numerous reports have been received of British aircraft returning safely to their bases in an amazingly damaged condition. One typical instance may be quoted. A "Wellington" bomber during a raid collided with a balloon cable which cut through the leading edge of the starboard wing, tore off the wireless aerial, damaged one of the airscrews, cut completely through the starboard aileron and severed it, ripped off the bomb doors, and did other smaller damage. Nevertheless, the machine succeeded in reaching home in safety. It is needless to say that in the last war any such mishap to an aeroplane would have meant its instant destruction. To-day our pilots have a confidence in the strength of the aircraft which they fly and of their ability to stand up to hard knocks, which is not without a powerful effect on the successes they have achieved. An interesting sidelight on this fact is seen in the reports which have been received of British pilots who have run out of ammunition continuing to attack the enemy by ramming or buffeting him. One method employed successfully consisted of flicking the tail of the German machine with the wing until the tail broke off and the enemy crashed. The British machine suffered some damage but returned safely to its base. Several instances, too, have occurred of British aircraft catching fire while under bombardment. In the last war, with the machines largely of wooden construction, fire almost invariably spelt immediate disaster. To-day it has been proved that with prompt and courageous handling fires on aircraft can be extinguished and that the machine after its ordeal can still be safely brought home.

Large-scale air attacks on this country were begun by the Germans on August 8th. At first they were principally confined to daylight hours and were primarily directed against our shipping in the English Channel and our southern coastal towns and ports. It took some time to convince the enemy that he was at last fighting a country which was prepared and able to hit back at him. At the end of twelve weeks, however, our fighters, anti-aircraft gunners, balloon barrage, and other elements of defence, had accounted with certainty for 2433 enemy bombers and fighters, omitting all those which were "probably destroyed" or "damaged." In that period over 6000 German airmen were killed or taken prisoner for a loss of 353 pilots on our side. Gradually the enemy started to change his tactics. He began by providing stronger fighter escorts for his bombing squadrons and continued to develop this plan until it reached an almost fantastic scale with hordes of fighters accompanying one or two bombers. His losses diminished somewhat, but equally, too, did the damage which he could do. Then came a change, in the making of which we can surely see an admission of the defeat of the earlier tactics. For day operations he virtually abandoned the use of bombers for large-scale attacks and sent over machines, primarily intended to be fighters, each carrying one or two bombs. With such aircraft he has continued to conduct spasmodic day-time "nuisance" raiding round our coasts and against London and other cities, towns, and villages near his bases in France and the Low Countries. Occasionally, large-scale attacks have lately been again attempted in daylight hours, but for the most part they have been

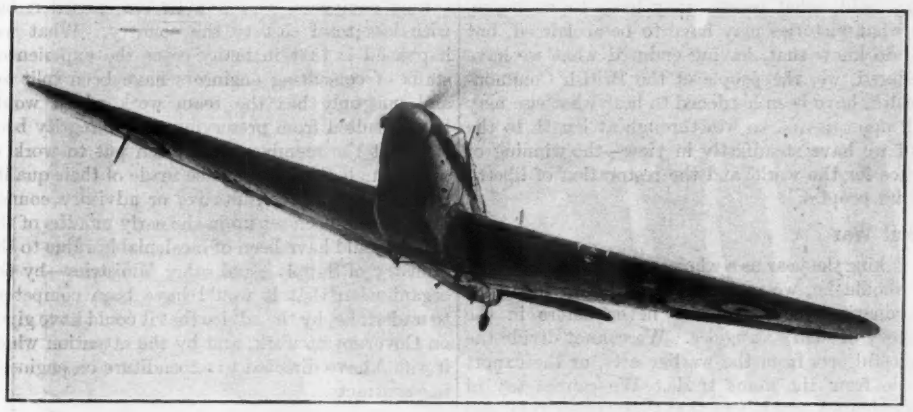


BOEING "FLYING FORTRESS" SUPER-BOMBER



THE "FLYING FORTRESS"—FRONT VIEW

broken up before or very soon after the enemy has crossed the coast. The plan of employing fighters as bombers is not one which would commend itself to an air force supremely confident of its strength. The fighter even carrying a couple of bombs loses much of its speed, and with its comparatively short range cannot hope to reach more than the fringe of the target area. Sent over singly or in very small formations, it has a fair chance of getting past our defences and of returning safely to its base; but it is evident that it is little more than a nuisance and that it cannot achieve any decisive result.



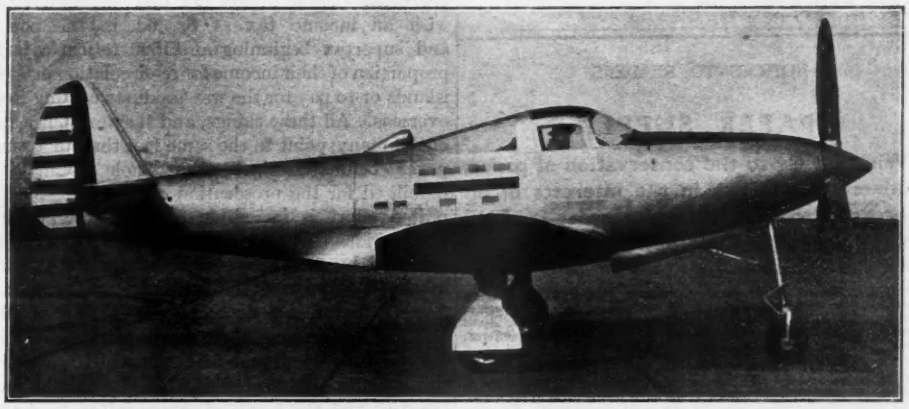
FAIREY "FULMAR" FLEET AIR ARM FIGHTER

By the beginning of September it was as clear to the Germans as it was to us that daylight air attacks were very costly, far too costly to be continued on the scale which they had previously followed. For the time being, at least, we had mastered them with our fighters and our guns. As was to be expected in these circumstances, the enemy resorted to night attacks. In these attacks he has certainly found a field congenial to his brutal soul. He need no longer fear our "Spitfires" and "Hurricanes"; he can fly, if he chooses, as he generally does, at such a height as to be beyond the effective range of our searchlights—and beyond the range at which any pretence to precision bomb aiming is a farce—he can come over in nearly all kinds of weather, for his code of warfare does not compel him to emerge from the clouds to seek his target, and, with the location of aircraft at night in its present state of development, he has much less to fear from our anti-aircraft guns than he has been taught to feel from his experience by day.

It may be noted that of the 2433 enemy aircraft destroyed during the twelve weeks beginning on August 8th, to which we have referred above, 341 were shot down by our anti-aircraft guns, an average of a little more than four each day. Our gunners have certainly given a good account of themselves by day. They have improved their practice to such an extent that on at least one occasion they have secured a direct hit on an aircraft flying at a height of about 5 miles. Nevertheless, it is no disparagement of them to say that their performance after night has fallen, judged by the number of machines which they shoot down, is far from equal to that which they have achieved by day. The gun barrage round London and other centres has now reached a great magnitude. It is not possible to say how many raiders have turned back before its intensity, but it can be asserted that night after night it has failed to prevent a number of machines from reaching their target area. It is certainly not the fault of our devoted gunners that their strenuous efforts by night meet with relatively little success. The fault seems to lie in the fundamental crudity of the system whereby we seek to destroy or damage an aeroplane in rapid flight by flinging lumps of steel at it more or less with our eyes blindfolded.

Meanwhile, our own bombers have been taking their toll on Germany, and will doubtlessly continue to do so with ever-increasing effort as the strength of our Air Force rises. Unlike the enemy, we have from the first concentrated on military targets and on works of all kinds which are contributing to his war potential. Our operations conducted from this country have extended from as far east as Danzig to as far south as Naples, and from all accounts have met with much success. The enemy, it would seem, is still as far off as we are from finding a means of preventing the attack of night bombers.

Herewith we illustrate four aircraft concerning which a few words may be said. The Fairey "Fulmar" is fitted with a Rolls-Royce "Merlin" engine. It is a fighter, designed for the use of the Fleet Air Arm, and is currently described as the Navy's version of the "Spitfire." The Boeing "Flying Fortress" is an American super-bomber, heavily equipped with defensive armament. It is understood that machines of this type with certain modifications will shortly be made available for British use. The Lockheed "Hudson," another American machine, has been in use by the Coastal Command of the R.A.F. for reconnaissance duties throughout the year and has repeatedly given a good account of itself in action. The Bell "Airacobra" is an American "pursuit plane," which is now being made in quantity for shipment to this country.



BELL "AIRACOBRA" PURSUIT PLANE

LOCKHEED "HUDSON" COASTAL RECONNAISSANCE AIRCRAFT

We take particular pleasure in acknowledging our indebtedness to Mr. C. M. Poulsen, the editor of *Flight*, for the loan of the photographs used to illustrate this article. A loss which we suffered at the last moment was repaired by his prompt and courteous assistance.

A MATERIAL FOR GASKETS.—A new material for cylinder head and other gaskets has been developed in Germany to take the place of asbestos-base gaskets—asbestos being a material no longer obtainable in Germany, says the *Automobile Engineer*. It is made up of three sheets or layers of the synthetic rubber Buna and two layers of steel wire netting, the wires of the two layers being placed at angles of 45 deg. with each other. Wire netting and rubber sheets are vulcanised together. Unlike natural rubber, which softens when exposed to high temperatures, Buna has a tendency to "tighten." Owing to the elastic nature of the rubber and the fact that the gasket is not coated with graphite, it is said to have better holding properties than conventional gaskets. The new gaskets are said to be resistant to hot water and hot oil up to 350 deg. Fah., to glycol, gasoline, and leaded gasoline.

THE NEED FOR ALUMINIUM.—Everywhere the demand for aluminium is exercising the resources of metallurgists and financiers. More than £30,000,000 has recently been allocated by the Aluminum Company of America to finance construction for defence work. The company will do most of the work with its own forces, because of the technical details involved. Expansion for national defence includes construction of hydro-electric projects at Glenville and Nantahala, N.C., which, together with smelting plants, is expected to increase the company's production of aluminium by 90,000,000 lb. yearly. The company will need additional power for its reducing plants in the Tennessee Valley, and has applied through its subsidiary, Nantahala Power and Light, for permission from the Federal Power Commission to construct a dam on the Little Tennessee River in North Carolina. Permission to build this project was sought about two years ago, but it was turned down then on the grounds that it would interfere with other plans for the valley.

The Engineer

JANUARY 3, 1941

VOL. CLXXI No. 4434

Contents

THE ENGINEER, January 3rd, 1941 PAGE

A SEVEN-DAY JOURNAL ... 1

SPECIAL ARTICLES—
AERONAUTICS IN 1940. (Illus.) ... 7
CIVIL ENGINEERING IN 1940. No. I. (Illus.) ... 4
ECONOMIC WAR AND THE ENGINEERING INDUSTRY ... 2
A RETROSPECT ... 10
ELECTRICAL ENGINEERING IN 1940. No. I. (Illus.) ... 16
NAVAL CONSTRUCTION IN 1940. No. I. (Illus.) ... 13
SHIPBUILDING AND MARINE ENGINEERING IN 1940. No. I. (Illus.) ... 14

NEW YEAR HONOURS ... 18
THE VICTORIA FALLS POWER COMPANY ... 18

LETTERS TO THE EDITOR—
TOWN'S GAS FOR PETROL ENGINES ... 12
DIMENSIONLESS CHARACTERISTICS OF TURBINES AND PUMPS ... 12

LITERATURE ... 12

NEWS AND NOTES—
CALENDARS, DIARIES, &C. ... 19
FORTHCOMING ENGAGEMENTS ... 20
MARKETS, NOTES AND NEWS ... 19
NOTES AND MEMORANDA ... 20
SIXTY YEARS AGO ... 18

FOUR-PAGE SUPPLEMENT—CIVIL ENGINEERING, ITALIAN WARSHIPS DAMAGED OR SUNK, LARGE ATLANTIC LINERS AND CIVIL ENGINEERING WORKS IN 1940.

NOTICES TO READERS

PAPER SUPPLIES

With a view to the conservation of paper, readers are advised, in the interests of all concerned, to place a regular order for THE ENGINEER with their newsagent or direct with the Publisher.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

*** *Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Postal Address: "The Engineer," 28, Essex Street, Strand, London, W.C.2.

Telegraphic Address: "Engineer Newspaper, Estrand, London." Telephone: CENtral 6565 (10 lines).

A Retrospect

WHEN one looks back on a year such as that through which we have just passed, the eye is drawn to the purple patches. The picture is not seen as a whole. Attention is caught by such tragic episodes as the defection of France, the massacre of Rotterdam, and the martyrdom of Coventry; or such glorious events as the evacuation of Dunkirk, the battle of the River Plate, the capture of Sidi Barrani, the magnificent Greek offensive, the great air battles of September, and the attack on warships in Taranto harbour. Such things as these we pick out one by one as the connoisseur examines with his glass the finest execution in an engraving or a musician touches upon a piano the best passages in a great symphony. But just as the engraving or the symphony cannot be properly understood save as a whole, so it is with a year of great events. We must not merely set episode against episode, gains against losses, disasters against triumphs, disappointments against realisations. To apprehend exactly what the twelve months have meant to us we must regard them as part of a terrible fabric still in the loom, but moving slowly but constantly to its destined completion.

Regarding 1940 in this large manner, we see far more in it that may lift up our hearts than that may depress them. We have won through months of bitter trials, trials that might have broken weaker spirits, and find ourselves not only unbeaten, undaunted even, but stronger, more determined, more justly confident than we were when the year opened. No one knows what the coming months may hold, what terrors may have to be borne, or what victories may have to be acclaimed, but we do know that, having endured what we have endured, we, the people of the British Commonwealth, have been hardened to bear what else may fall upon us and to win through at length to the end we have steadfastly in view—the winning of peace for the world and the restoration of liberty to its peoples.

Total War

Taking the year as a whole, as we have suggested it should be, we see engineering fitting into and dominating the pattern as never before in the history of man's struggles. We cannot divide the peaceful arts from the warlike arts, or the export trade from the home trade. We cannot say of some branches of labour that they are wasteful and of others that they are useful. All contribute in some measure to the war effort. The export trade no longer provides us with luxuries, but helps to pay for essential foodstuffs, or for aeroplanes, ships, and munitions of war. Even in the home trade those things that make life pleasanter, contribute their quota through the Purchase Tax to the cost of the war, whilst manufacturers with a hundred per cent. excess profits tax and the individual with an income tax at 8s. 6d. in the pound and supertax beginning at £1500 return a large proportion of their income for re-circulation in these islands or to pay for the war products coming from overseas. All these things, and they are but a few out of many, point to the same fact that, in a sense never before attained, the whole country is mobilised for the prosecution of the war. Such a united effort is incredible to the autocrats and totalitarians. What they believed could only be achieved by compulsion under the ruthless hand of the Gestapo and the concentration camp has been achieved by democracy and free peoples willingly suspending their privileges and liberties for the good of all and with the will to establish for ever the right of individuals to retain their liberties and the rights of communities to decide their own destinies. Against such determination, not alone of one country, but of all the parts of a vast commonwealth of free nations, the forces of tyranny will hammer in vain.

Engineers and the War

The best service that engineers can give in war is constantly to direct all their energies to the output of munitions and to other work required by the Services. As far as manufacturers are concerned, we have found no reason to doubt that during the year they were encouraged and helped by the Ministry of Supply and other Ministries to give of their best, and that they gave it. That they had their troubles goes without saying. They had difficulties with priority and export trade, whilst the Excess Profits Tax—an ill-considered measure—discouraged them when encouragement was needed and filled a good many of them with anxiety about the future. But they had little trouble with labour and, despite the disturbance of occasional bombing, were able to get on with their work in a way that was reflected in the periodical official reports on the rate of output of war materials.

When we turn from manufacturing to other duties we are less certain that engineers were as well and as fully employed as they ought to have been. It is well known that all the members of the engineering Institutions throughout the country were listed in a Central Register, upon which the Ministries could call for such men as they needed. A great many engineers have found employment through the Register, but we have some evidence that in some cases their technical and scientific knowledge is not being used as it should be, and that too often they are the subordinates of Civil Servants and others who have little or no knowledge of engineering and allow routine to interfere with the attainment of the best and most profitable results.

In another respect also the services of experienced engineers are not being used as they might be. It would, in our opinion, have been a wise measure to place much of the work that is now done by Departments with firms of experienced consulting engineers, who would have carried it out with less total cost to the country. What has happened is that in many cases the experienced staffs of consulting engineers have been split up, and not only has the team work which would have resulted from preserving their integrity been lost, but the members have been put to work in which the best use cannot be made of their qualifications. Had a consultative or advisory council of engineers been set up in the early months of the war it would have been of incalculable value to the Ministry of Supply—and other Ministries—by the organisation that it would have been competent to undertake, by the advice that it could have given on Government work, and by the attention which it would have directed to expenditure on engineering contracts.

Night Bombing

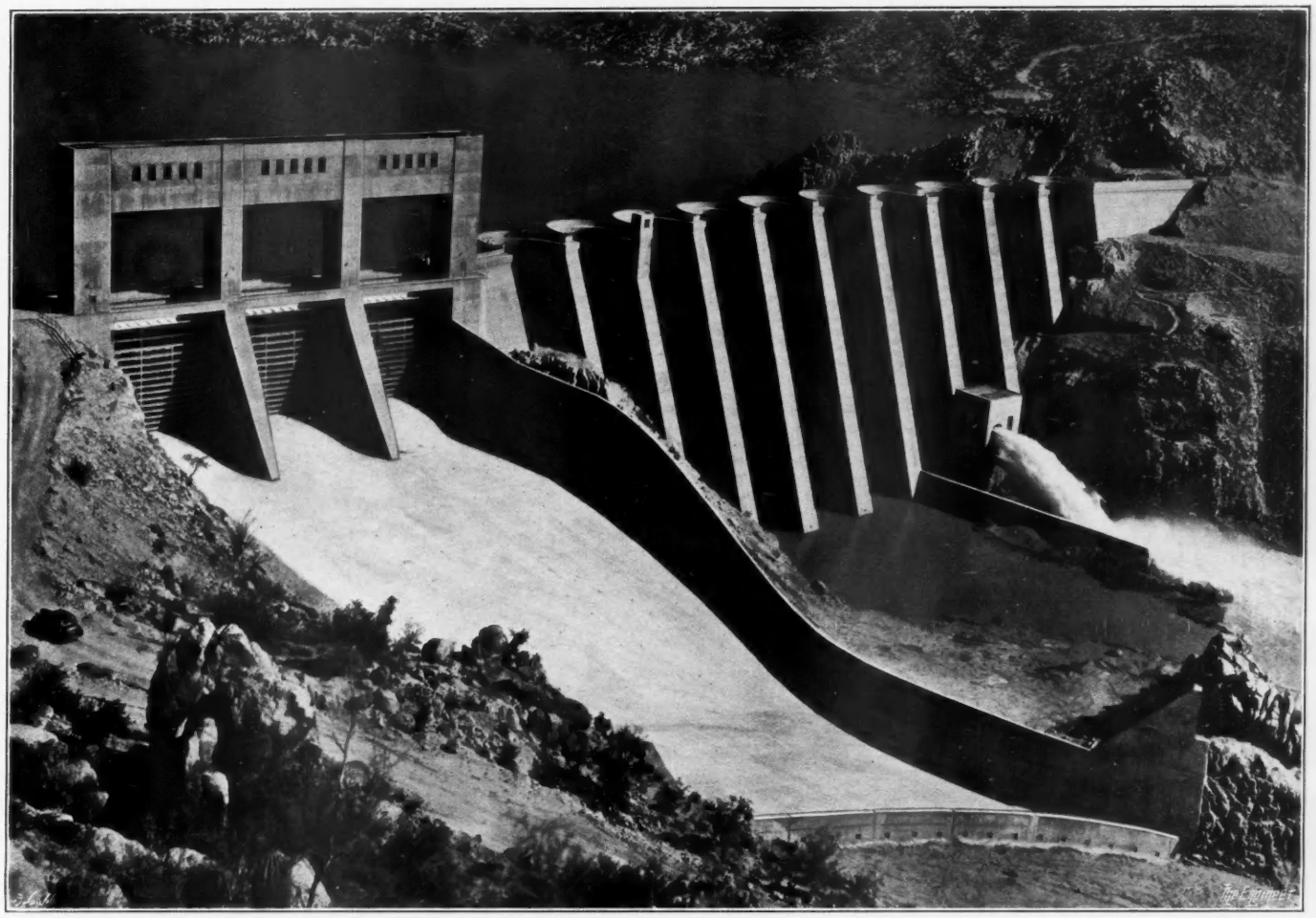
Finally, we are not satisfied that proper use has been made of the inventive capacity of engineers for *ad hoc* problems, of which night bombing is an outstanding example. This problem, of such vast moment to the country, has been in the hands of the Scientific Advisory Council, which has many duties of a varied nature to perform. The scientists on the Council are drawn from a number of vocations and very few of them have any engineering knowledge. They have worked on the assumption that the answer to the night bomber is to be sought in what may be called, rather vaguely, the scientific field. By that we mean the utilisation of devices or inventions which originate in the scientific laboratory and in the beginning fall outside the scope of the technician. Throughout the year the Council wrestled with the problem and there is as yet no distinct evidence that a solution is in sight. Bombing continues unabated and the best that can be achieved is the destruction of a few raiders per month more by good luck than scientific control. In these circumstances we have urged, and shall continue to urge, that technicians, in contradistinction to high-scientists, should be given an opportunity to try their hand at the problem. In our issue of December 13th we made the definite proposal that an *ad hoc* committee of engineers for the study of night bombing and nothing else should be set up at once and that a sum of £100,000 should be allocated to it for experimental work. We are not without hope that our suggestion will be adopted.

These few indications of the Government's failure to make full use of the engineering talent of the country present once more and in a very marked form the necessity that exists for the creation of an influential, single body which would represent British engineers. Such a body, properly constituted, would be able to speak with such a voice that even Governments would lend an ear to it. Save for the spineless organisation known as the Engineering Joint Council there is no such fully representative organisation in the land. We have some reasons for believing that the events of the past year have so impressed the engineering world that the establishment of such a powerful Council is being, at least, talked about once more. The war has made manifest the need of it and provides an atmosphere in which it may be easier to surmount the difficulties than when peace reigns. It is illogical that the profession of engineering, with its vast national responsibilities, should be voiceless in State affairs because it lacks a tongue with which to speak. Many good things will spring from this colossal evil of war. We sincerely trust that the organisation of the profession of engineering in a truly representative Council may be one of them.

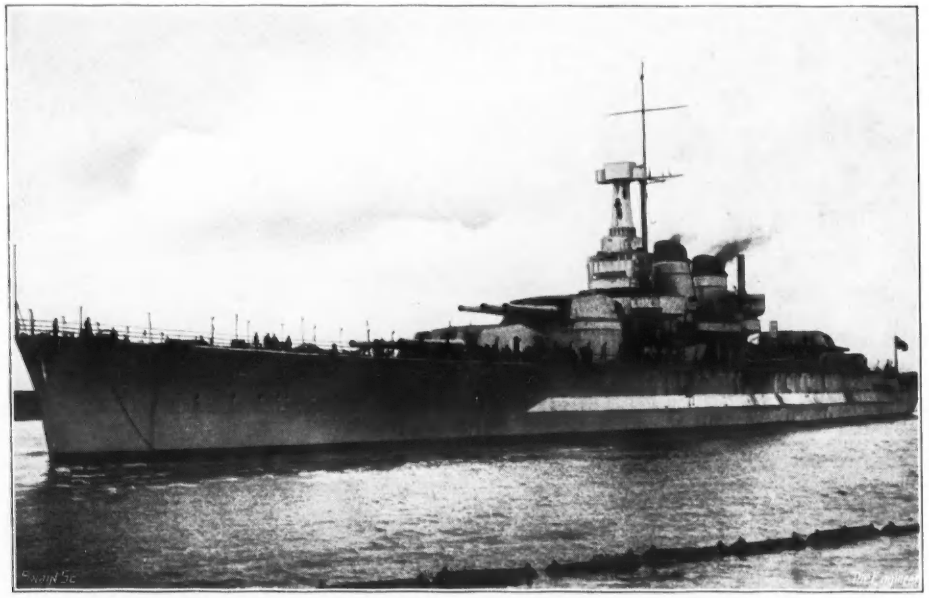
Labour

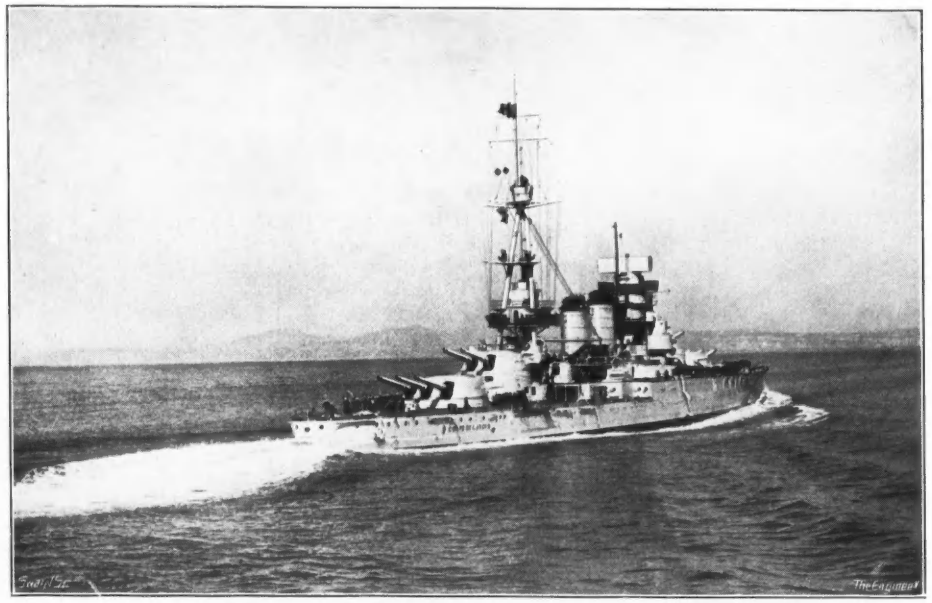
When, on May 10th, 1940, Mr. Winston Churchill became Prime Minister and called Mr. Ernest Bevin on to his Cabinet as Minister for

CIVIL ENGINEERING IN 1940

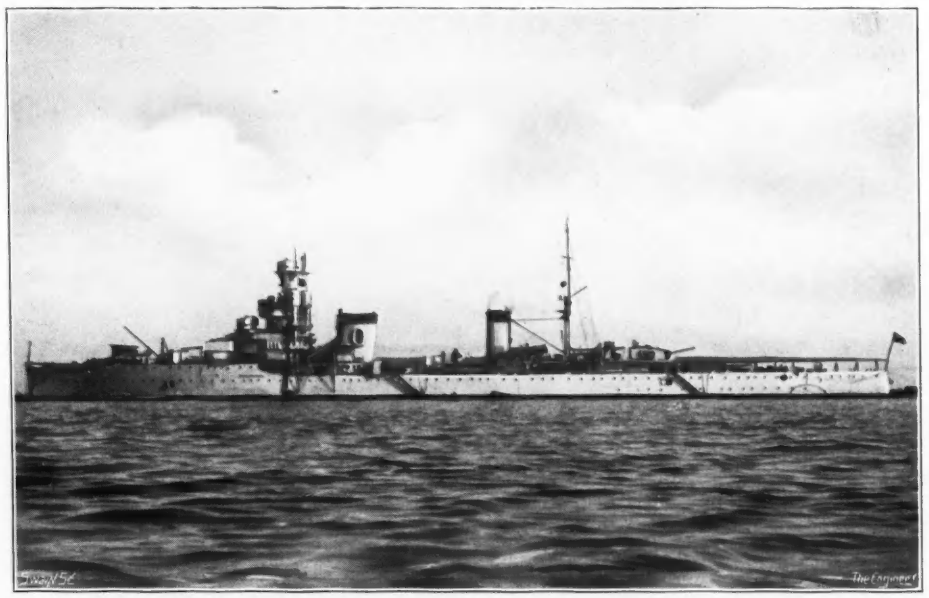


BARTLETT DAM ON THE VERDE RIVER, ARIZONA
ST. SAVIOUR'S DAM FOR GUERNSEY WATER SUPPLY



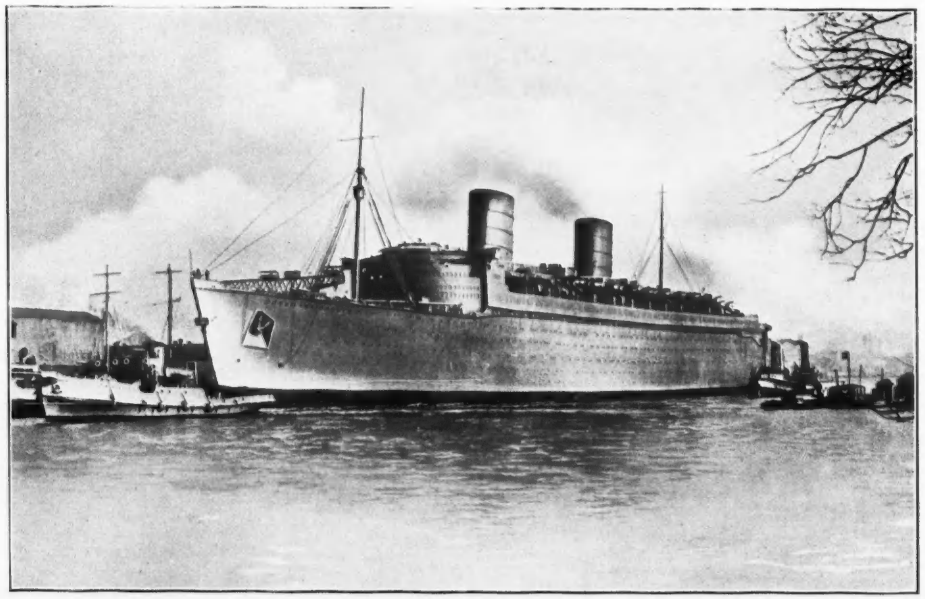


35,000-TON BATTLESHIP "LITTORIO"
CRUISER "BARTOLOMEO COLLEONI"

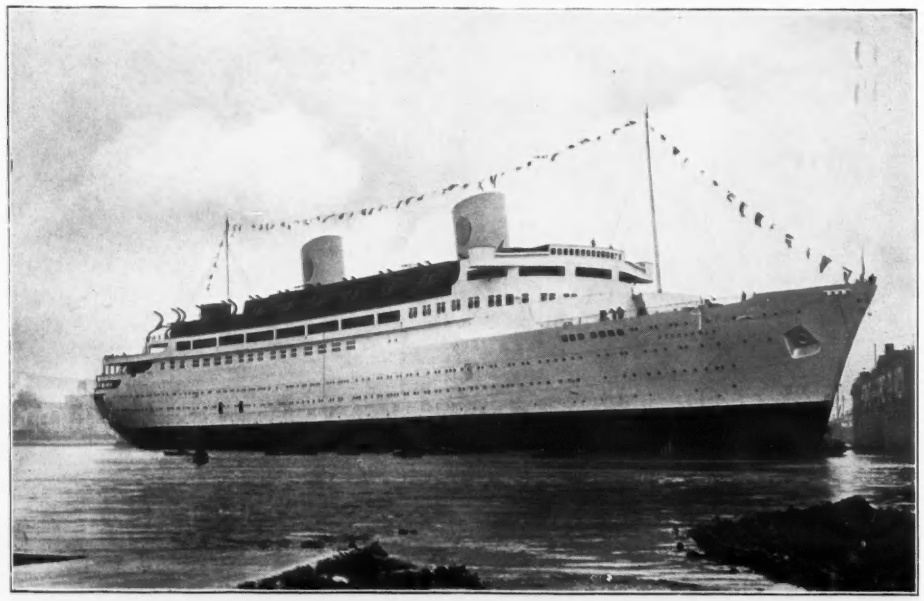


BATTLESHIP "CONTE DI CAVOUR"
DESTROYER "LIBECCIO"

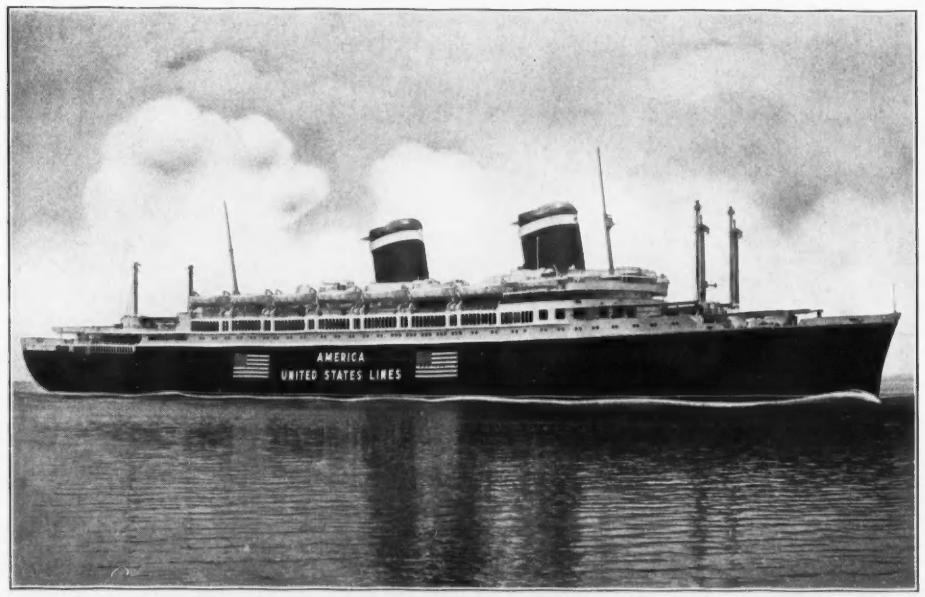
LARGE ATLANTIC LINERS OF 1940



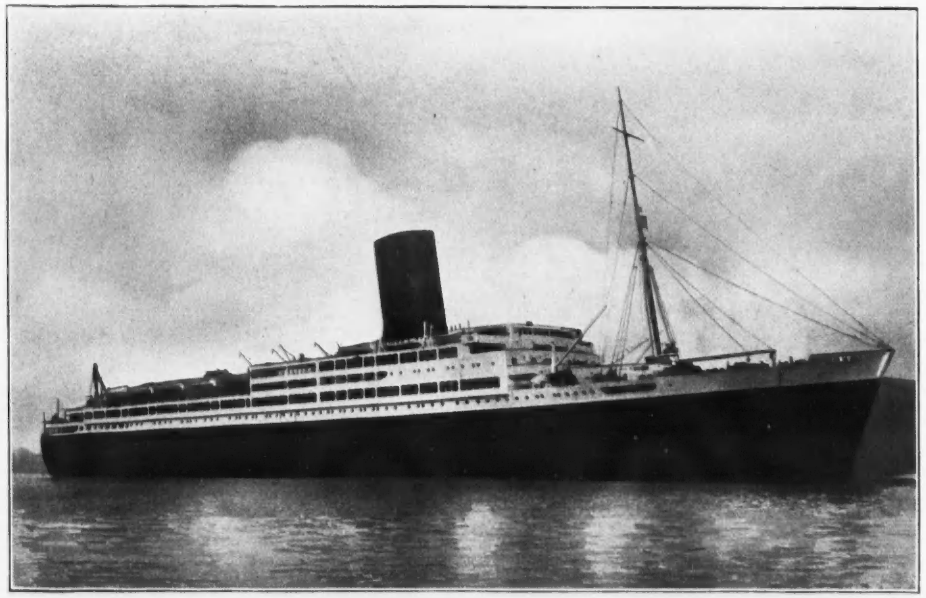
CUNARD WHITE STAR LINER "QUEEN ELIZABETH"



SWEDISH-AMERICA LINER "STOCKHOLM"

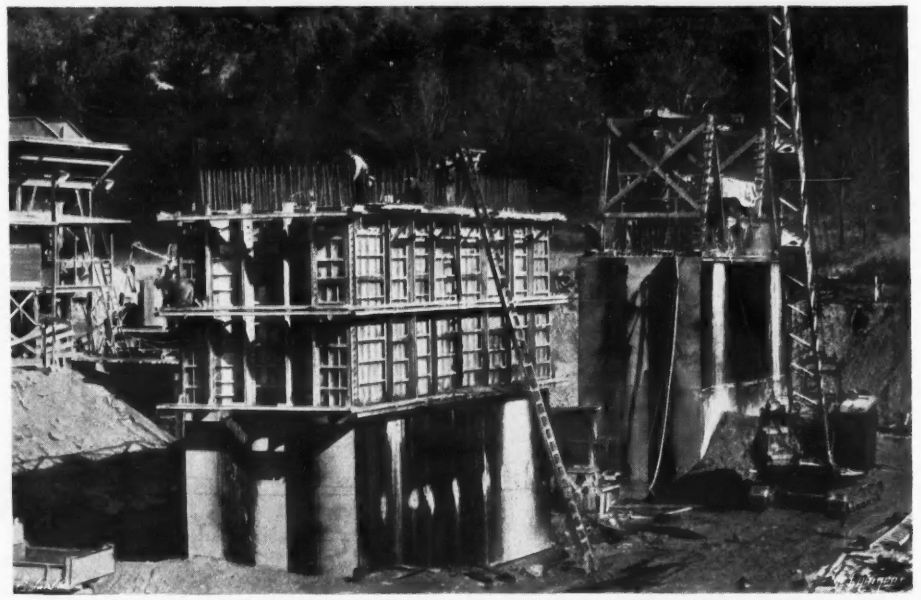


UNITED STATES LINER "AMERICA"



FRENCH SOUTH ATLANTIC LINER "PASTEUR"

CONCRETING TUNNEL SECTION AT MOBILE, ALABAMA
CONSTRUCTION OF WHARF AT BEIRA



SINKING CAISSONS FOR MERRIMAN DAM, DELAWARE AQUEDUCT
GYOBYU DAM FOR RANGOON WATER SUPPLY

Labour, a marked change in the labour situation began. It is for future historians to decide what Mr. Bevin's attitude had been from the outbreak of war up to that time, but there can be no question that once he found himself in a position of power under a new Prime Minister he set about putting right things that were wrong, and threw himself with all his energy into the task he had undertaken. Whether or not he could have persuaded the trades unions to forego some of their privileges before he became a Minister we need not discuss. The fact that he did persuade and even compel them to do so as soon as he had the power is what matters. He could not have done so without liberal promises. He promised that not only should the old privileges be restored when peace came back to the land, but that the working classes should then find a new world in which their lot was greatly improved. He, as he himself has said, has remained true to his socialistic principles, even when he has employed autocratic powers. It is said, and it is not inherently improbable, that he made it a condition of his accepting the Ministry of Labour that capital should cease to make profits out of the war and insisted upon the ill-considered 100 per cent. tax.

But despite all Mr. Bevin did there was throughout the year much criticism of the labour position. The figures of unemployment stood consistently at a high figure—over a million for part of the time—and it was contended by many that until a far smaller number was unemployed it could not be said that the country was exerting itself to the limit of its man power. The trouble was held, on one side, to be due to the reluctance of the unions to tolerate dilution; and, on the other, to the lack of skill of the unemployed. In the early days of the war several training establishments had been set up, and towards the end of last year a drive to augment intensive training was made. The number of training establishments was increased and the courses shortened, the technical colleges were asked to take up the work, and employers were urged to make special provision for trainees in their shops. The result of this effort cannot yet be seen; a few months must elapse before it can be expected to take effect. In the meantime it appears to be true that women are not being as freely employed as they were in the Four Years' War, and that the need for special training has in some cases been exaggerated. Experience has shown over and over again that in works organised for production women become expert in the operation of selected classes of machine tools in two or three weeks and that prior training is unnecessary. Equally there is much work that the wholly untrained man can do and for which such intensive training as he can receive in a few months is little or no advantage. It is not denied that there are many operations for which training is necessary. Some of them can perhaps be learnt in a few months, but for others, like jig making, tool setting and so on, it seems probable that a much longer experience is essential.

Looking at the matter broadly, we think it may be said that during the year we employed as many people as we were in a position to employ, that at any moment we can increase the number of operatives by using wholly untrained and female labour, and that in the interval we are building up a reserve of partly trained men who may at the end of their courses be fit to undertake work which is a bit above that possible to the wholly untaught worker.

There is a good deal more that might be said about labour during the war, but which it is inadvisable to say now. Most of it, we may add, is entirely to the credit of the workmen and workwomen of this country. They have done their work nobly under extremely trying and often dangerous conditions and we know from the periodical reports of Ministers that for the most part and in most industries they have accepted changes without demur and have worked to the top of their endurance to increase output. It has been truly said that it is in the workshops of the Empire that the war must be won. Not alone in this land, but in every part of the British Commonwealth of Nations that truth is accepted, and throughout the year Labour worked manfully to ensure that our fighting forces should never fall short of those materials of a thousand kinds that are required to ensure victory over the enemy.

Iron and Steel

The year 1940 in the British iron and steel trades was characterised by an abnormal war demand and intense pressure on the part of consumers to obtain delivery. These were the conditions in which the year opened. In January Sir Andrew Duncan, who had been appointed Controller of Iron and Steel at the outbreak of war, became President of the Board of Trade—and his place as Controller was taken by Sir Charles Wright. Official maximum prices were established at the commencement of the war, and in February the then maximum figures were advanced by 3s. on pig iron and 20s. on semis and heavy steel. It was stated at the time that these increases were made to cover the cost of imported materials, most of which came from the United States; but 105,000 tons of steel were imported in that month from Belgium. Although the importance of maintaining our export trade was realised, licences for the export of iron and steel materials were difficult to obtain. In March the South African Iron and Steel Corporation announced a big expansion at its works. In this month British scrap prices were advanced and it was hinted that there would be a further rise in iron and steel prices. In April it was sought to alleviate the intense pressure on the works and, at the same time, to ensure that the whole of the production was devoted to the war effort by a somewhat elaborate system of distribution. It was pointed out in THE ENGINEER at the time that this scheme, valuable as it was, might be subject to stresses arising from enemy action, and this became evident when in the following month of May Germany overran Belgium, Holland and the industrial districts of France. The official prices of certain steel products were increased in April, and it was understood at the end of that month that the British iron and steel production had reached a temporary maximum. In June a tightening up of the rationing scheme was effected. At the beginning of July the maximum prices of British iron and steel products were advanced by 3s. 6d. to 9s. for pig iron and 22s. 6d. to 27s. 6d. for billets, the prices for finished materials being raised in the same proportion. In July the collapse of France threw a fresh strain upon the British steel works which were producing at their maximum capacity. The distribution scheme, which had worked well, was simplified in September to cope with the additional pressure upon the steel works. In October the necessity for economising in exchange and the use of shipping led to the intensified collection of home scrap, and in November there was a further movement in British official prices, which were advanced by 35s. for billets, joists and sections and £2 for plates. From November to the end of the year the situation in the British iron and steel industry did not change. The demand for war purposes was unprecedented, but the Control, by careful supervision, was able to ensure regular supplies to consumers engaged upon war work, although those employed upon contracts which came within the category of non-essential production usually found that they had to wait some time for deliveries.

The Future

We must not conclude this Retrospect without a word about the future because throughout 1940 that subject was constantly raised, and because even now, at the beginning of a new year, it is time that engineers gave thought to it.

Everyone now expects that the world after the war will be very different from what it was sixteen months ago. It is hoped that nations, tired of conflict and the threat of conflict, will be in a mood to seek means whereby all can live and prosper in peace and happiness, and that some plan will be revealed whereby the recrudescence of war may be indefinitely postponed. That is a large political question, in which engineers will play their part as citizens, but over which they will have no more control than other citizens. There is, however, another class of problems with which engineers as manufacturers will be directly concerned. We mean those social questions which will arise in an acute form as soon as peace returns. They will have to be faced and it will be a grave mistake if engineers leave them entirely to the politicians and do not themselves endeavour to control in some measure the destinies of the industries in which they are engaged. We shall not be so imprudent as to suggest the subjects which will almost certainly demand consideration and action. But we do say, and we say it very earnestly, that engineering employers ought to begin without delay to consider by what means and in what way they can contribute to a changed social order without jeopardising the welfare of their industries. Almost certainly there will have to be some concession to new ideas. Some of those ideas are wholly subversive of the principles upon which the engineering industries of this country have been built and under which they have prospered. To repudiate all of them, to say we shall do in the future as we have done in the past and that the strength upon which our industries have been built up is the strength by which it must live, would, we submit, be disastrous. Far, far better will it be to endeavour to direct new thoughts into paths where reason prevails over prejudice and where the good that resides in the old principles is happily allied to the good that there is in the new.

That is the great task that lies before engineering employers; it is a stupendous task and a difficult one for them, because it must almost inevitably cross the threshold of politics. But they cannot safely shrink from it. They ought, as we have said, to begin now to think upon the problems that will come on the hem of peace and seek to discover means by which and through which harmony may be perpetuated in their industries. We urge upon them to consider not only in their individual capacity, but collectively a programme with which they can face the new world when the time comes upon them.

Conclusion

This Annual Review number of THE ENGINEER is very different from those which have appeared for many years. That is due, not alone to the restrictions imposed by the Press Censor, but also to the fact that a great deal of British and Continental work has been suspended. Had we been free to reveal all that was achieved by British and Dominion engineers throughout the year, we could have told a tale that would have shown the remarkable resources of the engineers of the British Commonwealth and the magnificent way in which, in every country, they responded to the call for ever more and more munitions of war. Some day, no doubt, that story will be told in full. For the present the details must be hidden and even the mass results are only dimly shadowed forth. Yet we do know that in the output of aeroplanes the liveliest hopes of the Minister of Aircraft Production have been exceeded, that the vast loss of Army equipment at the Dunkirk evacuation has been made far more than good, and, as our article on "Naval Construction" hints, that the output of ships of war of all kinds has been on an extraordinary scale.

When to all that these efforts represent we add the vast help which the United States are giving to us, and the preparations they are making to increase their output by many times, we may look towards the intensification of the war in full confidence that our commanders on the sea, on the land, and in the air will not be allowed to want for any of those things that engineers can supply.

We have in passing paid a tribute to all the workers in our factories who have carried on in exceedingly difficult circumstances. It is fitting that an equal or greater tribute should be paid to those engaged in transport by sea and land. No praise is too high for the work done by our railwaymen of all ranks and for the organisation which has been shown in maintaining and restoring services, under extremely trying conditions. Nor can we praise too highly the engineering branches of the big and little ships of our mercantile marine, which, in constant danger from enemy attack, have yet carried on courageously with a service which makes the continued existence of Great Britain possible.

But if we start awarding praise we shall not

know where to stop. After the surrender of the whole western coast of France to Germany this island was menaced by attacks from the air inconceivably greater than when the war opened. Since August London has been raided almost daily and many of our greater cities many times. The enemy may have hoped to break down the morale of the British people by these attacks, which often had no military objective. In this he failed, and will continue to fail, utterly. The result has been, not a weakening of our resolve, but a greater determination than before to prosecute the war with all our might, till a power which is as ruthless as a wild beast is overthrown and an era of reason and international goodwill is ushered in.

Literature

Remove the Shackles. By A. GRANT MCGREGOR. London: Sir Isaac Pitman and Sons, Ltd. 1940. Price 5s.

MR. MCGREGOR is an American mining engineer who has lived long in this country. As a side issue to his professional work he has devoted himself to national economics and has already published in various ways his proposals for reorganising the social and financial systems of the world. In this little volume he deals essentially with Great Britain and has so concentrated his attention on her affairs that he has, we suggest, overlooked international repercussions. Whether his plan would work if all the nations in the world agreed to adopt it is doubtful; what is not doubtful is that it will not work if one nation alone attempts to put it into operation.

Mr. McGregor's method of presenting his case reminds us rather of third degree in America or propaganda in Germany. It depends upon incessant repetition of one or two ideas. We pick more or less at random two or three sentences which exhibit his proposals in naked simplicity. We may premise them by saying that high wages and high salaries are the essence of his cure for unemployment and that manipulating exchange rates is his cure for international trading difficulties. "Prosperity can rule and profits can be greatest only if wages and salaries are paid on a scale that will keep consuming power in step with productive power." "If our imports were tending to exceed our exports plus foreign income, then sterling exchange rates should be lowered a little. This would lower the buying power of sterling for foreign goods, but at the same time it would raise the buying power of the foreigner's money for British goods." It is obvious how these two things hang together. Mr. McGregor believes in high prices combined with high wages; he hopes by the device outlined in the second quotation to preserve our overseas markets despite high prices.

High wages as a cure for unemployment is no new idea. Henry Ford advanced it many years ago and practised it in his works at Detroit. He said something to the effect that one's own employees were one's best customers. The contention is that if lots of people have lots of money, lots of things will be sold. America found that things did not quite work out that way, and after a period of boom, in which she proclaimed that she had found the secret of perpetual employment and a high standard of living, came a colossal slump. However good the idea might be in theory, it collapsed under "The slings and arrows of outrageous fortune." The fact is that the device is a perpetual motion machine—higher wages higher consumption, higher consumption more wages, and so on for ever. It depends, as will be seen, not only on the world's power to consume, but its *will* to consume. It would no doubt be very good for the tailoring trade if everybody bought a new suit once a week and threw away the old one. But people are not built that way. Not only do they like their old things, but a great many of them are quite content with moderate wages or moderate salaries for moderate work. Everyone knows how difficult it is to keep consumption up even amongst people who could well afford to spend more; they prefer to save. But when consumption fails these perpetual motion machines stop. No one can pay high wages for making commodities he is unable to sell.

Mr. McGregor seeks to get over another great difficulty as far as Great Britain is concerned by the second proposal we have quoted. Remember wages are to be high and prices are to be high in this country. Now, if our prices for the same products are higher in a foreign market than those of other countries, they will not be sold. Rigging the exchange might correct that if all goods were equally affected; it could only cause confusion if, let us say, machetes were too dear for the South American markets, whilst Dundee marmalade was just right. If we tried to sell machetes by "dumping" them at a low price, we should soon find ourselves unpopular overseas and the usual reaction would occur. It is hardly necessary to say that Mr. McGregor is an ardent free trader. But that apart, it is clear that whatever we do, consumption in foreign markets—essential to Great Britain—will fall unless we can compete with foreign producers and, again, if we cannot compete, consumption falls off and the perpetual motion machine stops.

On the matter of prices Mr. McGregor is quite old-fashioned. He detests control of any kind, national or otherwise, and believes firmly in the natural adjustment of prices by supply and demand. By maintaining high wages and high purchasing power he hopes that the demand will keep up and that prices may therefore be maintained. Yet he does not fail to notice that if prices get too high technological improvements must be invoked to bring them down again.

Perhaps we have said enough to show that we have found Mr. McGregor's ideas and proposals intriguing, even if we doubt their efficacy. Others may do the same.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents.)

TOWN'S GAS FUEL FOR PETROL ENGINES

SIR,—The information elicited by this correspondence is interesting, but not very informative on the point at issue, which, it may be recalled, was the air/gas ratio likely to be required by a petrol motor when using town's gas fuel without major alteration to the engine and when working on a full-power load.

Below are the salient data affecting this question, culled from the "Proceedings" of the Institution of Civil Engineers, Vol. CLXII, according to the handbook before me, and referring to a full-power test of a normal town's gas engine, 24·4 B.H.P.:—Calorific value of gas, 556 B.Th.U. per cubic foot; compression space, 333 cubic inches; volume swept out by piston, 1413·7 cubic inches; cubic foot of gas burnt per explosion (measured by meter), 0·0851; giving a mixture ratio of 8·6 air to 1 of gas without allowance for any attenuation of the air content on induction which would tend to make it slightly richer.

This engine would almost certainly be designed broadly speaking, according to the investigations of Sir Dugald Clerk.

Mr. Chamberlain, from his reply to my initial letter, would seem to infer that the very rich mixture which he found necessary to obtain full power from an unaltered petrol engine, viz., 4·1 air to 1 gas, might be explained by the lower compression of the petrol motor.

On the other hand, Mr. J. Jones, experimenting with a very high compression gas engine, finds a mixture of 5·7 air to 1 of gas necessary for maximum power output, both above mixtures being far richer than that shown in the test of the normal gas engine given above.

Mr. Chamberlain refers me to Dr. Pye's work on the I.C. engine in support of his own figure, but now comes the article by Professor W. T. David in your current issue flatly rebutting many of Dr. Pye's deductions.

In the higher ranges of compression for gas engines as adopted by Mr. Jones' firm I have no experience, but with considerable practical experience of gas engines from the days of flame ignition through a ported slide valve to the conception of the high-compression engine I still hold that a normal petrol motor tested under the conditions outlined will give maximum power with a mixture more nearly approaching 8 to 1 than 4·1 to 1 in practical working.

I am not concerned with point of ignition, exhaust gas temperature, completeness of combustion, or heat losses, or any of the other points involved in a comprehensive modern test, but purely with the single point of mixture ratio, it being assumed that the ignition is set or adjusted to obtain the best results under said conditions; but so far it would seem that, whichever ratio is the more correct in practice, the compression factor has little to do with it, judged by the results claimed by Mr. Chamberlain at one end of the compression scale and those claimed by Mr. Jones at the other, and contrasting both with the test figures given for a medium-compression engine conforming to the investigations of the Dugald Clerk era.

INQUIRER.

December 22nd.

DIMENSIONLESS CHARACTERISTICS OF TURBINES AND PUMPS

SIR,—It is difficult to decide which are the most suitable names for the dimensionless groups used in connection with turbines and pumps, and therefore Professor Addison's contribution is warmly welcomed.

Considering first the quantity $q/n\,d^3$, it was called the specific flow by myself because it represents the flow rate under particular conditions. Dr. McDonald[1] has recently called it the "Rateau output coefficient," since it seems to have first appeared in some of Rateau's early publications. I, like Professor Addison, dislike the word coefficient, used in this connection, and whilst still maintaining that specific flow is a good name, would suggest that "Rateau output number" is a better one. The word number seems to be the simplest word that can represent a quantity of zero dimensions. I would further suggest that the symbol q_R is a suitabie one to represent the quantity. Similarly, the quantity $g\,h/n^2d^2$ would then naturally be called the "Rateau head number," and be denoted by h_R. These names could be regarded as possible alternatives to Professor Addison's proposals. The word "ratio," however, does not appear to be as good as "number" in this connection, since it implies a comparison between two quantities of the same kind.

The quantity $n\,q^{\frac{1}{2}}/(g\,h)^{\frac{3}{4}}$, which has usually been referred to as the non-dimensional specific speed, is a more difficult quantity to name satisfactorily. That proposed by Professor Addison is open to the objection that it is not sufficiently distinctive. Other non-dimensional forms appear to be equally representative of type; in fact, the value of $q/n\,d^3$ at optimum efficiency has that property. A quantity $q\,n^2/(2\,g\,h)^{\frac{3}{2}}$ which will be seen to be proportional to n_s^2, and is also dimensional, seems to have a certain amount of vogue in this connection.[2] The group $d^2/h^{\frac{1}{2}}/q$ was described by Reynolds as a "law of comparison" of similar pumps and turbines. Although this group is not non-dimensional it can be made so by the introduction of g becoming $d^2\,(g\,h)^{\frac{1}{2}}/q$. It appears, therefore, that n_s is not alone in its properties, and that it would be difficult to justify the name "specific number." There is no doubt that n_s is closely related to the normal form of specific speed N_s, and it is a pity if this relationship cannot be expressed in the name. Dr. Camerer was the originator of specific speed, and it has occurred to the writer that "Camerer type number" would express the three essential characteristics, viz.:

(*a*) The specific speed relationship.
(*b*) The use of the number as an indicator of type.
(*c*) Its non-dimensional character.

J. JENNINGS.

Birmingham, December 16th.

REFERENCES

[1] "Dimensional Analysis of Centrifugal Pump and Blower Performance," G. G. McDonald, B.Sc., Ph.D., "Trans.," Inst. Eng. and Shipbuilders in Scot. (in course of publication).

[2] *Engineering*, August 9th, 1940, page 115, and September 6th, 1940, page 196.

GAS FILLING STATIONS FOR MOTOR TRANSPORT.—Now that low-pressure gas stored in bags has again come to be used as a fuel for motor transport vehicles, the British Commercial Gas Association has performed a useful service to the owners of motor vehicles by publishing in a convenient form a booklet containing the full particulars of existing gas filling stations in all parts of England and Wales and Scotland. It includes no less than 430 stations which are situated either at garages or on gas undertakings' own property. The stations are conveniently grouped under their county headings, and are given in alphabetical order. In many cases the hours of business are given, and there are notes stating if the supply is metered or unmetered, and whether a certificate of bag capacity is needed. Blank pages are left for additional entries, but as the number of gas filling stations increases, revised lists are to be issued. It is pointed out in an accompanying memorandum that the use of low-pressure gas for motor vehicles has a number of advantages, and one main disadvantage. The advantages include economy, as the running cost of a gas-driven vehicle, generally speaking, works out at a figure which is equivalent to petrol at only 1s. 4d. a gallon. The cost of conversion is not high, refilling is only a matter of a few minutes, and the vehicle can be operated alternatively on gas or petrol. Against these advantages is the low range, which varies according to horsepower from 14 to 20 miles. Provided, however, that there is a sufficiency of gas filling stations, this low range should not be a deterrent. Copies of the booklet, on "Gas Filling Stations for Motor Transport," can be obtained at a price of 2d. each from the British Commercial Gas Association, Gas Industry House, 1, Grosvenor Place, London, S.W.1.

Naval Construction in 1940

By FRANCIS McMURTRIE, Captain R.N., A.I.N.A.

No. I

IN war time it is impossible to provide a complete review of the progress of naval construction, since so much must necessarily be secret until the return of peace. But from the information officially released some idea can be gleaned of probable developments, which is all that will be attempted in the present article.

Of the nine battleships building for the Royal Navy at the end of 1939, two were due for completion last year. These are the "King George V" and "Prince of Wales," which were launched on the Tyne in February, 1939, and on the Mersey in May, 1939, respectively. Vickers-Armstrongs, Ltd., have been responsible for the construction of the former and Cammell Laird and Co., Ltd., for that of the latter. These, it will be recalled, were the two firms which turned out the "Nelson" and "Rodney," experience which must have proved extremely valuable in dealing with the successors of those ships.

Three more ships of the "King George V" class, with a displacement of 35,000 tons, a speed of over 30 knots and a main armament of ten 14in. guns, were scheduled for delivery during 1941. With their completion an extremely useful squadron of five up-to-date battleships will become available, a fact which can hardly fail to impress both our foes and our friends.

In 1939 there were laid down four bigger battleships, the first two of which are to be named "Lion" and "Temeraire." Except that their displacement will be in the region of 40,000 tons and that they will be armed with 16in. guns, no official details of them have been published. Vickers-Armstrongs are building the "Lion," and Cammell Laird and Co. the "Temeraire." Firms concerned in the construction of the other five battleships in hand are John Brown and Co., Ltd. (one of each type), the Fairfield Shipbuilding and Engineering Company, Ltd. (one of each), and Swan, Hunter and Wigham Richardson, Ltd. (a 35,000-ton ship).

One of the outstanding facts which has made it possible to give these capital ships exceptionally high speed without in any way weakening their offensive or defensive qualities is the reduction of boiler weights by about 15 per cent., as compared with those of the "Nelson" and "Rodney," the fruit of modern improvements in boiler design. Additional weight saving was effected in the ships of the "King George V" class by the adoption of quadruple turrets. Hitherto these immense turrets had been avoided by all nations except the French, who installed them in the "Dunkerque," "Strasbourg," "Richelieu," and "Jean Bart," and have apparently found them satisfactory. They are not a new idea, of course, having been a feature of the design of the five battleships of the "Normandie" class, laid down in 1913–14. Only one of these ships was ever completed—the "Bearn," converted into an aircraft carrier—so the quadruple turret has taken a long time to hatch.

In case it may be imagined that the 14in. guns of the "King George V" class are unduly light weapons, it should be added that they have an effective range greater than that of the 15in. guns mounted in earlier ships, as measured by the perforation of any given thickness of armour. Presumably also their rate of fire is more rapid, in view of the lighter projectile and more modern type of mounting.

Whether any more capital ships have been begun under war emergency programmes is, of course, unknown, but the balance of probability would appear to be against it, in view of the predominant demand for warships of lighter types.

Other additions to British capital ship strength are the completion of the reconstruction of the battleships "Queen Elizabeth" and "Valiant," on lines similar to the "Warspite's" transformation three years ago. As rebuilt, these three units, if not as good as new, may be considered to be more efficient fighting ships than any enemies they are likely to be called upon to meet.

Four aircraft carriers of 23,000 tons, the "Illustrious," "Victorious," "Formidable" and "Indomitable," were due to commission in 1940. Since the "Illustrious" has taken a prominent share in the war in the Mediterranean, it is probable that the other three have also been completed. From an official photograph which has been released, it is clear that in design these ships are slightly improved editions of the "Ark Royal." A further development will follow in 1942, when the "Implacable" and "Indefatigable," of similar dimensions, but slightly varied design, are due for delivery.

Three of these aircraft carriers ("Illustrious," "Victorious" and "Indomitable") were contracted for by Vickers-Armstrongs, and one each by Harland and Wolff ("Formidable"), the Fairfield Company ("Implacable") and John Brown and Co. ("Indefatigable").

Of the value of a modern aircraft carrier in offensive operations there can no longer be any question, since the spectacular success of the Fleet Air Arm at Taranto last November—see THE ENGINEER, November 29th—was achieved by aircraft from the "Illustrious" and "Ark Royal." In future enemy ships cannot hope to ensure their safety by remaining in harbour, since it has been proved that booms and minefields do not confer immunity from attack by torpedo-carrying aircraft.

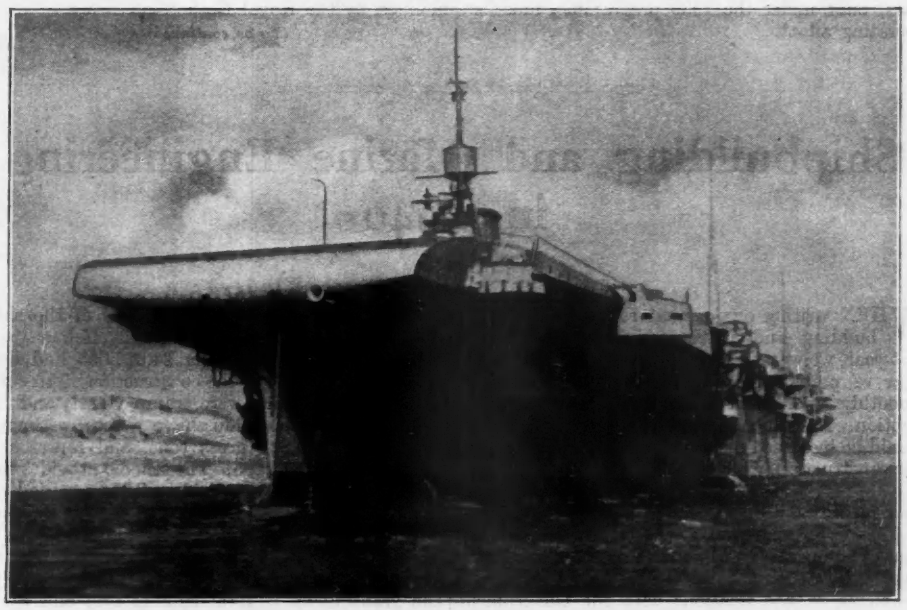
Quite a formidable squadron of cruisers must have been completed last year. There were due for completion in 1940 the "Fiji," "Kenya," "Mauritius," "Nigeria" and "Trinidad," ships of about 8000 tons designed displacement, with a speed of 33 knots and an armament of twelve 6in. and eight 4in. (anti-aircraft) guns; and the "Dido," "Euryalus," "Naiad," "Phœbe," "Sirius," "Bonaventure" and "Hermione," of 5450 tons, 33 knots, and an armament of ten 5·25in. guns. With the possible exceptions of the "Trinidad" and "Sirius," all these cruisers should have passed into service by now, and their names may be looked for in the news in due course.

Undoubtedly many more cruisers are under construction. Four more cruisers of the "Fiji" class and three of the "Dido" class had been begun before the outbreak of war, while four cruisers — probably improved "Fijis" — were authorised under the 1939 Navy Estimates. How many others have been provided for by war votes must remain a matter for conjecture until hostilities cease.

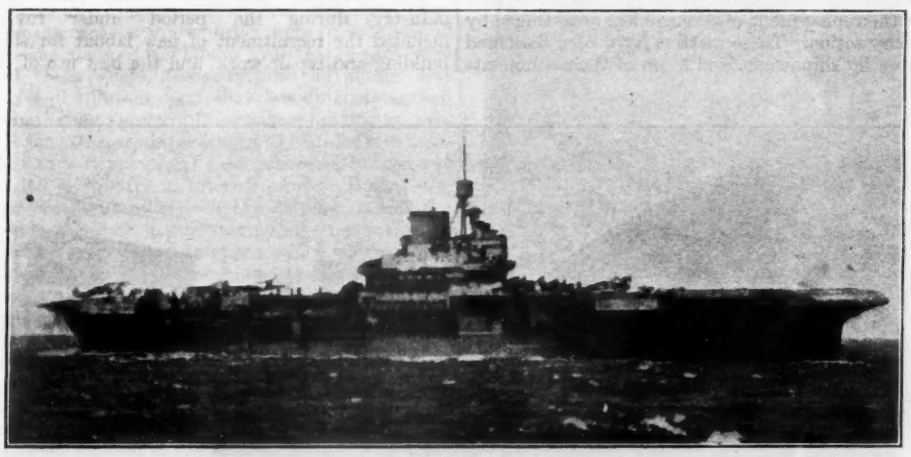
Four fast minelayers of 2650 tons laid down in the early part of 1939 should be approaching completion, if indeed they are not already finished, since their value at the present juncture should be considerable.

Destroyers must be even more in demand than cruisers or minelayers, since in no category of surface warship have casualties been so severe. Sixteen ships of the "Lightning" class, of 1920 tons, and eight of the "Javelin" class ("N" series), of 1690 tons, were building in 1939 and some of them may be at sea by now. Obviously war programmes must have provided for several more flotillas of destroyers, which, to save time, have no doubt been ordered to the "Lightning" or "Javelin" designs. In view of the fine records set up by British destroyer builders in the last war, it may be expected that in the course of 1941 deliveries of destroyers will become numerous and frequent. Pending that consummation, the fifty destroyers acquired from the United States Navy may be certain of a busy time. All will, of course, have had the elevation of their guns increased to enable them to repel attacking aircraft.

Nine submarines were under construction, and a tenth, the "Thetis," was being refitted when war began. Four more were authorised under the 1939 Estimates, and others have doubtless been put in hand under war votes. From official announce-



BOW VIEW OF H.M. AIRCRAFT CARRIER "ILLUSTRIOUS"



H.M. AIRCRAFT CARRIER "ILLUSTRIOUS"

ments it would appear that all the nine above-mentioned submarines have passed into service; indeed, two of them, the "Tarpon" and "Triad," have been lost.

Twenty vessels of about 900 tons, the "Hunt" class, were laid down in 1939 and must all have been delivered by now. Originally rated as fast escort vessels, in view of the urgent need for escorts of this kind, it is probable that many more have been put in hand.

Four slower escort vessels of the "Black Swan" class, which have now reverted to their former classification as sloops, have doubtless also passed into service.

No information is available concerning the number of motor torpedo boats built in 1940, but the total is probably considerable.

For minesweepers there has been an unceasing demand, resulting in the acquisition of large numbers of fishing trawlers for this purpose. By now twenty fleet minesweepers of the "Bangor" class, built under the 1939 programme, must be operating afloat.

Other vessels which should have passed into service this year include the depot ships "Hecla" and "Tyne" and fifty-six patrol vessels of the whaler type, now rated as corvettes. Many more of the latter are known to be building, some of them in Dominion shipyards.

The Royal Australian Navy has completed two sloops and has launched several fleet minesweepers, of which nearly fifty are believed to have been put in hand. The "Arunta," first of three Australian destroyers of the "Tribal" type, was launched in November. Twelve motor torpedo boats and a number of corvettes have also been built.

In the Royal Canadian Navy, two destroyers of the "Tribal" type, thirty-four minesweepers, fifty-four corvettes and twenty-four motor torpedo boats represent the war programme of construction so far as it has been published.

Of the fifty destroyers acquired from America, already mentioned, six have been assigned to the Royal Canadian Navy, and another is being manned by the Royal Netherland Navy.

(To be continued)

Shipbuilding and Marine Engineering in 1940

No. I

WHEN writing our annual review of the shipbuilding and marine engineering industry last year, we were in a position to state that after a year of preparation that industry was working smoothly and efficiently on full war-time production. In January last year it was felt that there would be increased demands for naval and mercantile construction, which would undoubtedly be met. We are pleased to record that during the past year new records for ship production were reached.

The keynote of 1940, it has been well said, was that of co-operation, which was noted in the handling and settlement of the industry's internal problems, in the relations with the Government Departments and the Admiralty, the dealings between individuals and firms and between the employers and the men. Under those favourable conditions it was not surprising that new figures of output were set up for the production of warships and commercial vessels and, what is of equal importance, the quick repair, overhaul and re-conditioning of existing tonnage, including ships which had suffered war damage.

Shipbuilding Appointments and Changes

At the end of January Mr. Chamberlain, who was then Prime Minister, announced that, following the practice of the last war, the Government had decided that the Admiralty should be responsible for merchant shipbuilding and repairs, as well as for naval construction. For that purpose Sir James Lithgow, was appointed to the Board of Admiralty at the end of January as Controller of Merchant Shipbuilding and Repairs, and Sir Amos Ayre was transferred from the Ministry of Shipping to the Admiralty to become Director of Merchant Shipbuilding and Repairs. At the end of March we recorded with regret the death of Sir John Gilmour, the Minister of Shipping, who had laid the foundations of the Ministry and equipped it to meet the tasks it had to face. Sir John was followed by Mr. R. S. Hudson, who was later succeeded by Mr. Ronald Cross, who is carrying out his duties with purposefulness of action. Towards the end of the year Mr. J. M. Ormston, the shipbuilding manager of Vickers-Armstrong, Ltd., was elected President of the Shipbuilding Employers' Federation; Mr. H. B. Robin Rowell, Mr. Louis L. Dunlop, and Mr. Wilfred Ayre, Vice-Presidents; and Mr. G. R. Green, Chairman of the Conference and Works Board; with Mr. A. L. Cochrane, Vice-Chairman. We recognise in these appointments the selection of men endowed with leadership and strength of mind, in whose hands the welfare of the industry is assured.

The Merchant Construction Programme

Looking back, we see clearly the farsightedness of the Government scheme for aiding ship construction. When the outbreak of war took place some of these proposals were not proceeded with as originally planned, but the shipbuilding loans and grants were retained. A White Paper which was issued in August gave some details of the shipbuilding position as it then existed. It was stated that, in all, loans totalling £4,817,005 had been approved in respect of the construction of fifty-five ships, fifty of which were tramp vessels and five cargo liners. These ships have a total estimated tonnage of 239,822 gross tons, and represent a total cost of £6,311,295. The scheme provides that the loans shall be repayable within a period not exceeding twelve years from the date of the first advance, the rate of interest having been fixed at 3¾ per cent. per annum. Under the British Shipping (Assistance) Bill provisions were made for the granting of a total sum of two and a-half million pounds for the building of cargo vessels ordered after March 28th, 1939, and completed not later than December 31st, 1941. The White Paper states that the Minister of Shipping had authorised the initial grants under the scheme, which, we may recall, are at rates which vary from 16s. 6d. per gross ton for coal-burning or dual-fired cargo liners, to 10s. per ton for tramp ships. other than those burning coal or equipped for dual firing. It was estimated, the White Paper states, that about one hundred ships would rank for grant, the initial grants amounting to about £320,000.

The Government's tonnage requisitioning scheme came into operation during the year, and its terms aroused some criticism on the part of shipowners, particularly with regard to the provisions provided for the replacement of tonnage lost or damaged by enemy action. These matters have been discussed freely by shipowners and some of their comments were recorded in our 1940 Seven-Day Journal. The main difficulty seems to be the high cost of replaced tonnage, which may be anything from 39 to 75 per cent. higher than the original cost of the ships. It is rightly felt that this matter should be looked into by the Government before the time comes for such replacement to be made.

From time to time we have been able to record progress in shipbuilding in Canada, Australia, and the United States of America. In December it was announced that orders had been placed in America for sixty ships, for early delivery, and in order to accelerate the building programme new shipyards were being laid down with multiple berths to achieve mass production.

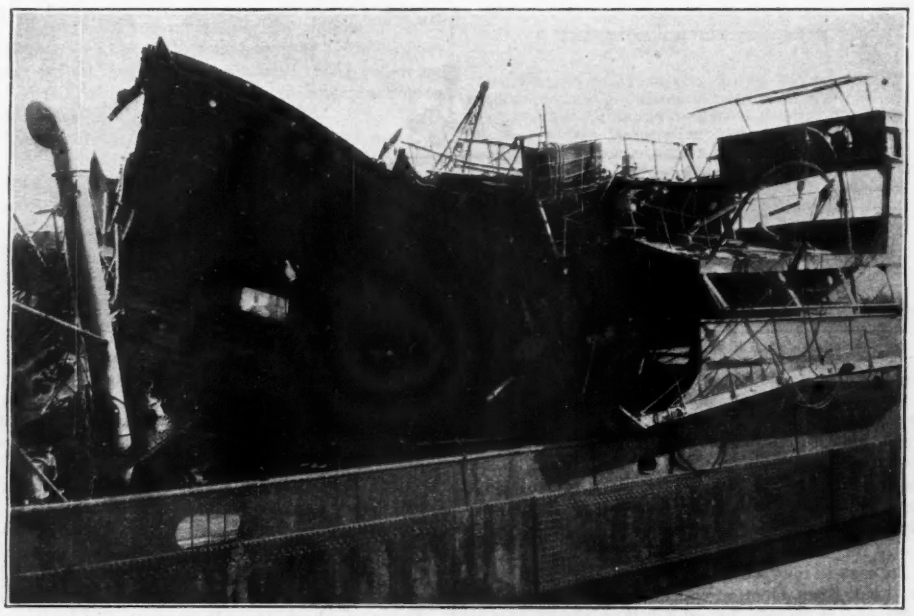
Little has been made known with regard to the propelling machinery for these ships and the tonnage which is under construction in our own shipyards, but it may be expected that modern steam turbine practice, oil engine construction, and the building of improved reciprocating steam engines will all play their part. The same will hold with regard to the rival claims of the water-tube and the Scotch boiler, both of which are available in improved forms. One effect which will undoubtedly be felt will be the reduction in the number of available oil engine building firms, many of whom, on the Continent, cannot supply engines for British-built ships. There is no doubt that the number of types of ships will be limited, and that a high degree of simplicity and interchangeability of parts will be insisted upon in order to facilitate maximum production. It is known that construction is already proceeding on a number of 10-knot tramp ships with a lesser number of cargo liners having a designed speed of about 16 knots.

Progress in Ship Repairs

Apart from the destruction of ships by torpedo and mine, many ships have suffered severe damage from attacks by aircraft, but although sinkings have been heavy, and will be referred to elsewhere in this article, many ships have come safely to harbour. It was early recognised that two classes of repair work would be necessary: first-aid repairs, to permit a ship to proceed to sea; and final repairs and reconditioning, which might take a longer time. In both classes of repairs there has been plenty of scope for ingenuity, and a wide variety of work has been undertaken with the object of getting ships back into service as soon as possible. It can be well imagined that damage resulting from underwater or abovewater explosives leads to many buckled and twisted plates and girders. Particularly in the first-aid repairs, welding is being used freely, as it is more easily applied to this type of repair work than riveted construction, which, of course, still plays its part. Some examples of such damage and temporary repair are illustrated in the accompanying engravings.

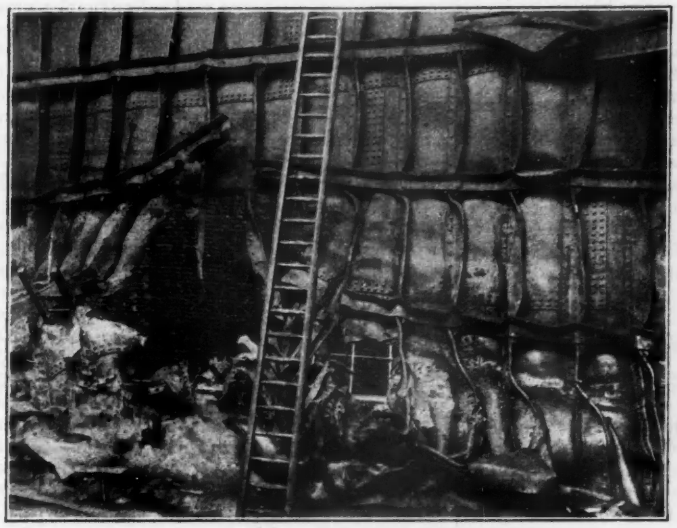
Labour and Wages

The principal problems which faced the industry during the period under review included the recruitment of new labour for shipbuilding and repair work, and the best use of the

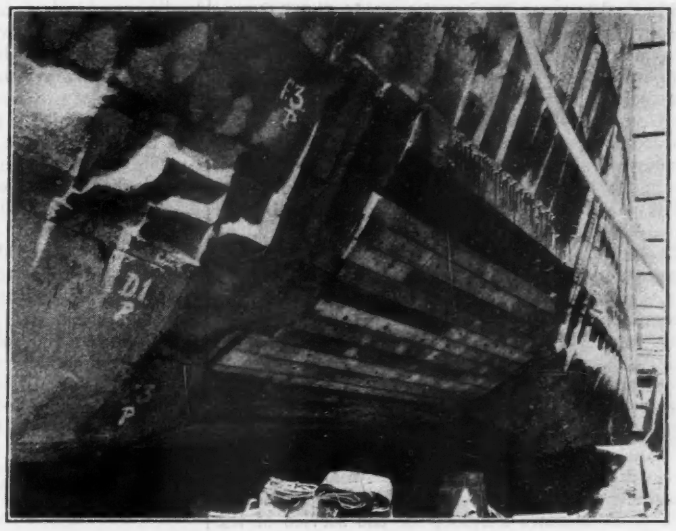


TANKER WITH DECK LIFTED AND SUPERSTRUCTURE DAMAGED

labour which was available. When the war began close upon 30,000 shipyard workers were unemployed. By the beginning of 1940, it is stated by the Ministry of Labour, about half of these men were already in employment, and the reduction in the number of unemployed workers increased as the year went on. Alongside this re-absorption of men, many thousands of workers were brought in from outside the industry, and a large increase in the number of men employed in the shipbuilding and repair yards took place. During the summer an attempt was made to investigate the capacity of the remaining idle shipyard workers and local panels were set up, composed of representatives of the employers and the men and the Ministry of Labour. The investigation showed that a substantial proportion of the men interviewed would be unsuited to shipyard work even if they were put through a refresher course. It was also revealed that the so-called reservoir of shipyard labour consisted in a large part of men who were no longer available for the industry. The inquiry began with skilled men and was later continued with semi-skilled and unskilled men. It was known that many shipyard workers had joined the Forces under the Territorial and Reserve sections, and with the shortage of skilled labour steps were taken to release a number of men from the three defence forces in order to allow them to assist in the greatly accelerated shipbuilding and ship repairing programme. The full use of the labour available was further ensured by the appointment under the Minister of Labour, Mr. Ernest Bevin, of a Production Council and Labour Supply Board. Under that Board, Labour Supply Officers were appointed in the principal shipbuilding centres, whose duties were to see that full use was made of the labour available in each yard and that, where necessary, full advantage was taken of dilution, and that labour customs and demarcation agreements were not holding up production. It was also arranged to transfer men from yard to yard in special cases where assistance was needed with urgent priority work. During the year discussions between the employers and the unions resulted in the temporary relaxation of existing customs and practices, which was accepted by a wide range of shipbuilding trades. Cancellation of holidays was also accepted, but safeguards were made to avoid breakdowns in health which might have occurred. In the period under review there has been a steady increase in shipbuilding wages and, following the advance of 2s. to time-workers and 4 per cent. to pieceworkers granted in September, 1939, a further grant of 5s. per week to both time and pieceworkers was made in February last year. In September last the unions again presented a claim for a further increase of 10s. a week, mainly on the ground of increased living costs. In November the case of the unions was considered at Carlisle by the Shipbuilding Employers' Federation, and it was announced that the Federation did not see its way to granting a further increase, as there had been no change in circumstances, which, in its opinion, justified such an increase. It is understood that the claim will come before the National Arbitration Tribunal, which was set up by the Ministry of Labour last August under the presidency of Mr. Justice Simonds.



DAMAGED FORWARD HOLD OF CARGO SHIP



TEMPORARY REPAIR COMPLETED

Trends in Design

Already in this article we have indicated that the interplay of the interests of the Admiralty and the Ministry of Shipping, while permitting flexibility in the design of merchant ships under the emergency programme, will endeavour to increase output by restricting the variety of types. While the demands of war-time ships must retard the application of new ideas, there is every evidence that progress is still being made both in hull and machinery design, and, without doubt, war-time experience will lead to better and more efficient ships. In past years we have referred to the increasing use of high fatigue limit and other special steels, steel castings, and the wider adoption of welded constructions.

In a paper entitled "Welding as a Substitute for Casting," read before the Institution of Engineers and Shipbuilders in Scotland in February last, Dr. S. F. Dorey indicated the progress which had been made in the substitution of welded mild steel parts for ferrous castings, and showed the possible reduction in scantlings and the saving of weight thus obtained. The development of marine engineering during the last half century was ably illustrated by Dr. A. L. Mellanby in the Thomas Lowe Gray Lecture of 1940, entitled "Fifty Years of Marine Engineering." Turning to boiler engineering Major W. Gregson dealt with the practical limitations of pressure and temperature in marine steam engineering in a paper read before the Liverpool Engineering Society in March last, while in the same month Dr. J. B. O. Snedden, in a paper delivered before the Institution of Engineers and Shipbuilders in Scotland, described the possibilities of modern steam propelling units for cargo steamships. Mr. W. J. Belsey's March contribution to the Institute of Marine Engineers was a valuable summary of the operating results of turbo-electric propulsion in Europe and America. The use of geared oil engines for marine propulsion, which have been widely adopted in the new programme of the United States Marine Commission, was outlined in one of the November papers of the American Society of Naval Architects and Marine Engineers given by Lieut.-Commander W. D. Leggett, Junr., who gave an interesting historical survey of the progress made. The powering of large ships with geared turbine machinery formed the subject of Sir Stephen Pigott's Parsons Memorial Lecture before the North-East Coast Institution of Engineers and Shipbuilders, which was reprinted in our last two issues. Reference to the increase in the importance of the light alloys for shipbuilding and marine engineering work was made in Mr. W. A. Woodeson's Presidential Address to the North-East Coast Institution of Engineers and Shipbuilders in November last, while the same subject was emphasised in Mr. A. C. Hardy's paper on the ships of the future which was delivered before the Institution of Engineers and Shipbuilders in Scotland quite recently.

DAMAGED BULKHEAD OF TANKER

Large Passenger Liners of 1940

In to-day's special Supplement we reproduce engravings of four large passenger liners designed for North and South Atlantic service, which were outstanding ships of the year which has just ended. It is rare for us to have to describe ships we have never seen in their completed form, whose present whereabouts are not to be revealed and which have still to take up, we hope, in times of peace the services for which they were originally designed.

Pride of place among these ships must be given to the new Cunard White Star liner "Queen Elizabeth," which, on Monday, February 26th, left her fitting-out basin at John Brown's Clydebank yard, and with the aid of tugs made her way successfully to the Tail-of-the-Bank off Greenock. Our Supplement illustration shows the liner on her way down the Clyde. The size of the world's largest ship is at once apparent, and attention may be called to her streamlined bridge structure, her two large funnels, and the absence of ventilating cowls. With the exception of one or two lifeboats which were carried for emergency service the boat davits are without lifeboats. Sailing under sealed naval orders the "Queen Elizabeth" took a special northerly course to New York, where, on Thursday, March 7th, she dropped anchor at the quarantine base at Staten Island after what must be looked upon as the strangest maiden voyage in seafaring history. The New York harbour authorities waived the usual quarantine rules and allowed the liner to proceed at once to the Cunard pier at New York. Later in the year she sailed from that port for a secret destination. The report which was received on her maiden voyage stated that the trip was a most successful one. The ship was in charge of Captain J. C. Townley, and Chief Engineer Sutcliffe was responsible for the machinery. There was sufficient rough weather to show the excellent sea qualities

of the liner, and although there had been no opportunity to make trial runs of her machinery, her engines ran remarkably smoothly and at times speeds up to 30 knots were recorded.

In conclusion, we may recall some of the leading particulars of this fine ship. She has a length of 1031ft., with a promenade deck of 724ft. Her breadth is 118ft., and her depth to the top of the lounge structure 120ft. There are fourteen decks, and the measurement is 85,000 gross tons. The propelling machinery comprises a quadruple-screw arrangement of Parsons single-reduction geared turbines, each turbine unit consisting of one H.P., two I.P., and an L.P. turbine. The designed output is something over the 180,000 S.H.P. developed by her sister ship the "Queen Mary." The engines are arranged in two separate engine-rooms, and steam is supplied by twelve high-pressure Yarrow water-tube boilers of the latest side-fired pattern, with a designed working pressure of 425 lb. per square inch, and a superheated steam temperature of 750 deg. Fah. The boilers were built at Clydebank to drawings supplied by Yarrow and Co., Ltd., of Scotstoun. Tne generating sets are four 2200-kW B.T.H. geared turbo-generators supplying current at 225 volts. They take steam at full boiler temperature and at a working pressure of 300 lb. per square inch. The emergency generators comprise two Mirrlees-B.T.H. oil-engine-driven dynamos with a designed output of 133 kW each. In his Parsons Memorial Lecture, Sir Stephen Pigott said that the turbines, gearing, shafting, and propellers of the "Queen Elizabeth" and the "Queen Mary" are the same in all respects.

Another important Atlantic liner which we also illustrate is the "Pasteur," which was built and engined by the Société des Chantier et Ateliers de Saint Nazaire Penhoët for the service of the Compagnie Navigation Sud-Atlantique of Paris. The liner was nearing completion at the end of 1939, but for an official account of her construction we waited until early in the spring of 1940, when she was described in a special number of our French contemporary, the *Journal de la Marine Marchande*. The "Pasteur" was built to replace the ill-fated liner "L'Atlantique," which was lost by fire. She has an overall length of nearly 697ft., with a beam of 88ft., which is extended to over 90ft. at the promenade deck. The depth moulded to the promenade deck is 65ft. 7in., and the liner has a loaded draught of about 31ft. 6in. She has a measurement of 29,253 tons. Her cargo capacity includes accommodation for about 67,100 cubic feet of general cargo, 56,200 cubic feet for motor-cars, and 24,000 cubic feet of refrigerated chambers. The passenger accommodation includes public rooms and berths for 287 first class passengers, 126 second class passengers, and 338 third class passengers. A crew of 519 is carried, making a total ship's complement of 1270 persons.

The "Pasteur" has a designed speed of 25 knots, and her propelling machinery consists of a quadruple-screw arrangement of Parsons geared turbines taking steam from ten Penhoët oil-fired, water-tube boilers, having a designed working pressure of 441 lb. per square inch and a final superheated temperature of 385 deg. Cent. The fuel rate is 0·695 lb. per shaft horsepower-hour, which includes the various ship's services. It is of interest to record that the length of the engine-room is 100 m., which compares with 128 m. for the former liner "L'Atlantique," while the boiler-room length is 43 m. compared with 48 m. The insulation of the boilers was carried out in glass silk, supplied by the Société Isover, of Paris, which, in design of panel, is generally similar to that made in this country by Glass Fibres, Ltd., of Firhill, Glasgow. The panels are covered with asbestos cloth, and between the glass silk and the cloth there is a layer of aluminium foil. Three turbo-generators are employed for lighting and power. Most of the auxiliary machinery is of French manufacture, but among British firms which supplied machinery and apparatus to the liner may be mentioned the refrigerating plant designed and built by J. and E. Hall, of Dartford, the salinometers of the Evershed and Vignoles Dionic pattern, and the Welin-MacLachlan boat davits. The "Pasteur" has not taken up her ordinary service to South American ports, sailing from Bordeaux.

The "Stockholm," a view of which we also reproduce in to-day's Supplement, was approaching completion at the Monfalcone yard of the Cantieri Riuniti dell' Adricatico to the order of the Swedish-America Line for its service between Gothenburg and New York. The first "Stockholm," a triple screw motor liner of 28,000 gross tons, was launched on May 29th, 1938, and was nearing completion at the fitting-out basin when she was destroyed by fire. Somewhat protracted negotiations with the underwriters resulted in the building of a replace ship, shown in to-day's engraving, which was scheduled to be delivered to her owners towards the end of 1940.

On March 10th last the replace ship was successfully launched from the Monfalcone yard, about ten months after the keel had been laid; our illustration shows the well-advanced state of the ship. Considering the difficulties brought about by the war the time of construction is very creditable to the builders. Some of the leading particulars of the "Stockholm" are as follows:—Length overall, 625ft.; breadth on the water line, 82ft. 4in.; loaded draught, 28ft. 6in.; and measurement, about 28,000 gross tons. The appearance of the liner is enhanced by her sharply raked stem, which is rounded at its upper section, and the cruiser stern. There are two well-spaced funnels with two pole masts. In all there are ten decks. The passenger accommodation is primarily designed for North Atlantic service, but is suitable for short cruises. Provision is made for about 1350 passengers, which number, however, is reduced to about 650 cabin and tourist passengers when cruising. A crew of about 600 is to be carried.

A feature of the hull design is the provision of a long central corridor which runs the whole length of the state room decks. Extensive air-conditioning plant is installed for service when cruising in tropical waters. In order to minimise rolling two unusually large streamlined bilge keels have been fitted, in addition to which anti-rolling tanks are also provided. By this means it is hoped to reduce the angle of rolling from about 15 deg. to 5 deg.

The propelling machinery of the "Stockholm" consists of a triple-screw arrangement of C.R.D.A.-Sulzer single-acting, two-stroke oil engines, each of which is coupled to a single propeller. Each engine has ten cylinders having a bore of 720 mm. and a stroke of 1250 mm. The engines have a designed running speed of 110 r.p.m., and the total output of the three units is 22,000 I.H.P., which corresponds to a service speed of about 19 knots. The maximum rating is about 27,000 I.H.P. The engines, which were constructed for the first ship and were undamaged by the fire, were constructed at the builders' San Andrea engine works at Trieste, under licence from Sulzer Brothers, of Winterthur. The auxiliary machinery includes five Polar oil engine-driven generating sets of 850-kW output, and the heat from the exhaust gases is utilised in Cochran boilers. The "Stockholm" is larger than her sister ships the "Gripsholm" and the "Kungsholm," and she was built to the designs of and under the supervision of Mr. E. Th. Christiansson, the technical director of the Swedish-America Line.

The outstanding ship of the year to pass into service in the United States was the twin-screw passenger and cargo liner "America," the flagship of the United States Lines Company, which represents the largest and most important mercantile shipbuilding contract completed in America, and was entrusted to the Newport News Shipbuilding and Dry Dock Company, of Newport News, Va. A full description of this interesting liner was given in a paper read before the American Society of Naval Architects and Marine Engineers in May, 1940, by Mr. Harold F. Norton and Mr. John F. Nichols, the naval architect and the chief engineer of the Newport News Shipbuilding and Dry Dock Company. That paper was reprinted in THE ENGINEER in August and September.

The "America" has an overall length of 723ft., a maximum beam of 93ft. 3in., a beam of 91ft. 11in. at the water line, and a depth moulded to the promenade deck of 73ft. 5in., with a loaded draught of about 32ft. 6in. She has a displacement of 35,440 tons, and her gross tonnage is about 27,000. Her propelling machinery was constructed by the builders of the ship, and consists of a twin-screw arrangement of impulse and reaction turbines driving the propellers through single and double-reduction gears of De Laval manufacture. The turbine sets each consist of one H.P., one I.P., and one L.P. turbine, and the total designed output of the two sets is 34,000 S.H.P. They take steam from six Babcock and Wilcox water-tube, three-drum, express type, oil-burning boilers, with a total evaporating surface of 63,000 square feet. The designed evaporation of the boilers is 315,000 lb. per hour normal, and 346,000 lb. maximum when supplied with feed at 300 deg. Fah. In normal service the steam conditions are 425 lb. gauge and 725 deg. Fah. at the superheater outlet, corresponding to about 400 lb. gauge and 715 deg. Fah. at the turbine stop valves. The main electric generating plant consists of four geared turbo-generating sets, each with a designed output of 600 kW, with a General Motors oil engine-driven emergency set of 150 kW capacity. A full description of the hull, passenger accommodation, and machinery of this fine ship is given in the five articles already referred to. During the year the "America" made several successful cruising trips from New York to the West Indies.

(To be continued)

Electrical Engineering in 1940

No. I

DURING 1940 there was plenty of interesting electrical work on hand. But unfortunately much of that work comes under the same ban of censorship that has affected other pages of this issue.

Turbo-generators

We are informed by C. A. Parsons and Co., Ltd., that many important turbo-generating installations were put into commission during the year. The second 50,000-kW, 3000 r.p.m. turbo-alternator for the Sydney County Council, Australia, and the third 40,000-kW set at the same speed for the City of Cape Town were set running. The alternators for the latter machines are of the high-voltage concentric conductor type, designed to operate at 33,000 volts. High-voltage turbo-alternators for an output of 30,000 kW at a speed of 3000 r.p.m. were installed in two towns in England. In a British power station the third 15,000-kW turbo-alternator reconstructed to operate at 3000 r.p.m. at a frequency of 50 cycles was set to work, and a second 15,625-kW turbo-alternator was put into commission in South Africa. Among industrial machines installed in this country and abroad the most interesting were a 3000-kW geared turbo-alternator for a copper-gold mine, and a 3125-kW "pass-out" geared turbo-alternator for a rubber company, both machines being installed in Canada.

Work was and is proceeding on two 53,500-kW, 1500 r.p.m. turbo-alternators for a British power station, and on a 40,000-kW, 3000 r.p.m. turbo-alternator for the Electricity Supply Commission, South Africa. The British machines each comprise a two-cylinder turbine driving a 50,000-kW, 33,000-volt alternator and a 3500-kW house alternator on one shaft line. The alternator for the South African set will generate also at 33,000 volts. Orders for 30,000-kW turbo-alternators are in hand for a British power station, the State Electricity Commission of Victoria, Melbourne, and for India. The two latter machines are of the high-voltage concentric conductor type, the Australian alternator generating at 22,000 volts and the Indian alternator at 33,000 volts. A second 15,000-kW turbo-alternator to operate at 3600 r.p.m. has been ordered for Canada. The turbine for this unit will be of the single-cylinder type, with duplex exhaust. A number of smaller turbo-alternators were ordered.

Among the work carried out by Richardsons, Westgarth and Co., Ltd., in 1940 was the complete remodelling of a 15,000-kW municipal turbine set. The machine was put into commercial operation. The modification virtually meant the rebuilding of the machine using some of the parts of an existing single-cylinder unit and converting them into a twin-cylinder machine by the addition of an H.P. cylinder. The modification, the firm states, has resulted in a very much higher overall efficiency and general improvement in operating characteristics. The redesigned turbine was also arranged

for two bleeding points for supplying steam to a two-stage feed heating system which was also supplied by the firm.

The third of three high-pressure, back-pressure turbo-generators was put into operation in a North-Western industrial plant. These units are each designed for an output of 4000 kW when operating with a live steam pressure of 900 lb. per square inch absolute and a temperature of 780 deg. Fah., and exhausting against a back pressure of 190 lb. per square inch absolute, and are of the high-efficiency, combined-impulse and reaction type. Reduction gear of the single helical type made by the firm has also been fitted to these turbo sets to reduce the turbine speed of 5500 to 500 r.p.m. for driving the tandem D.C. generators.

A number of smaller turbines for industrial plants were also completed, and surface condensing plant having an aggregate of approximately 18,000 square feet was despatched from the firm's shops during the year.

Although the year 1940 did not show any striking new developments in the design of generating plant, the volume of new business transacted by Metropolitan-Vickers Electrical Company, Ltd., is felt to have been highly satisfactory. As far as larger plant was concerned, new orders consisted very largely of repeat orders and included thirteen complete generating units ranging in output from 20,000 kW to 51,500 kW, seven of which were for British Corporations.

The volume of new export business was very satisfactory. One of the more important orders covered a complete power station of 60,000 kW capacity for Turkey. The turbine plant for this station includes three 20,000-kW, 3000 r.p.m. turbo-alternator sets each complete with condenser plant, feed heating equipment, and auxiliaries.

Another important export order was one for a 20,000-kW, 3000 r.p.m. turbine plant for the China Light and Power Company, in whose station a 12,500-kW Metrovick unit was recently installed. Several other smaller units were ordered for China, including a number of sets of the self-contained type. It is of interest to note that since Metrovick 33-kV turbo-alternators were first put into commission about 3½ years ago, no single instance of interruption of supply due to failure of any of these machines has occurred. The total capacity of the 33-kV sets ordered to date is some 750,000 kVA, of which 270,000 kVA is already operating in service.

Motors, Alternators, &c.

Apart from the large volume of special work undertaken for war purposes, Bruce Peebles and Co., Ltd., received in 1940 many orders for normal products, such as converters, generators, motors, transformers, and mercury arc rectifiers, from public and private Electricity Supply Authorities and industrial works. Although export work was overshadowed by demands at home, many important orders were received for rotating electrical plant and transformers from the British Dominions, India, and other countries abroad. Amongst orders received for converting plant were three 1500-kW (Fig. 1) and two 500-kW motor converters for India; a 400-kW synchronous motor generator, also for India; a 400-kW mercury arc rectifier for mines in Scotland; a 250-kW rectifier for a public supply authority in England, and one of 250 kW for a textile mill in England. Many orders were received for alternators for direct coupling to steam turbines through gears, and in this connection it is of interest to record that the trend of modern development is towards the use of geared alternators for constantly increasing outputs as instanced by a 3750-kW unit ordered for Australia. Other orders for alternators included a 2000-kW geared steam turbine-driven alternator for South Africa; a 1487-kW hydro-electric unit for South America; a 750-kW geared unit for Australia, and a small engine-driven alternator for Chile.

An unusually large number of salient-pole A.C. machines were built during the year by Metropolitan-Vickers Electrical Company, Ltd. Among the large vertical-shaft water wheel alternators completed or under construction are two of 22,200 kVA for New Zealand (Fig. 2); two of 24,000 kVA for Arapuni, New Zealand, duplicates of the first two installed there by the company two years ago, and three of 19,000 kVA running at 500 r.p.m., an unusually high speed for vertical-shaft machines of this size. In the horizontal-shaft type work is in hand on the fourth identical machine of 12,500 kVA at 250 r.p.m. for the Madras Government, a 600 r.p.m. alternator of 8060 kVA for South Africa, and others of smaller capacity.

A large number of the company's standard solid-pole machines were also built, especially in the larger sizes, up to 6000 kVA. They are mostly gear-driven turbo-generators, but include also several synchronous motors and condensers at 1500 r.p.m., as well as synchronous motors of rather lower speed for motor-generator sets, in both large and small sizes. Nearly all of this plant, amounting to some 250,000 kVA capacity, is for export orders. Business in engine type alternators has been considerably expanded during the year. These machines range from the largest standard sizes down to smaller sizes than have usually been built in the revolving-field, salient-pole type. Among special machines recently developed are a number of medium-sized synchronous motors, fitted with separate three-phase starting windings, thus combining to a valuable extent, it is claimed, the good starting characteristics of the ordinary induction motor with the known operating advantages of the plain salient-pole synchronous motor.

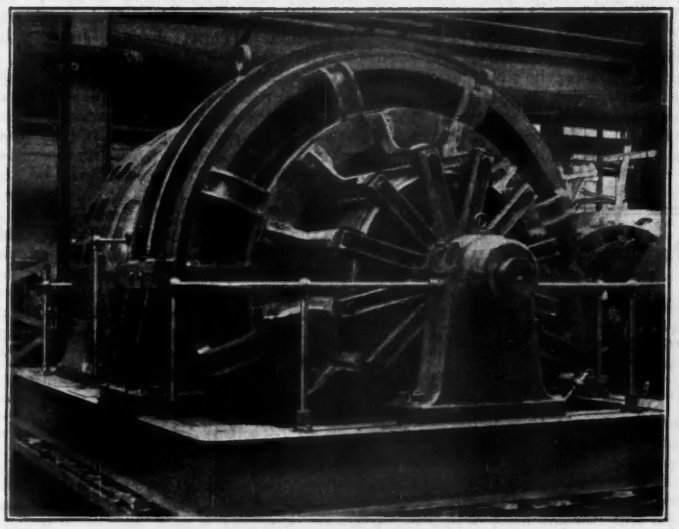


FIG. 1—1500-KW MOTOR CONVERTER SET FOR INDIA—BRUCE PEEBLES

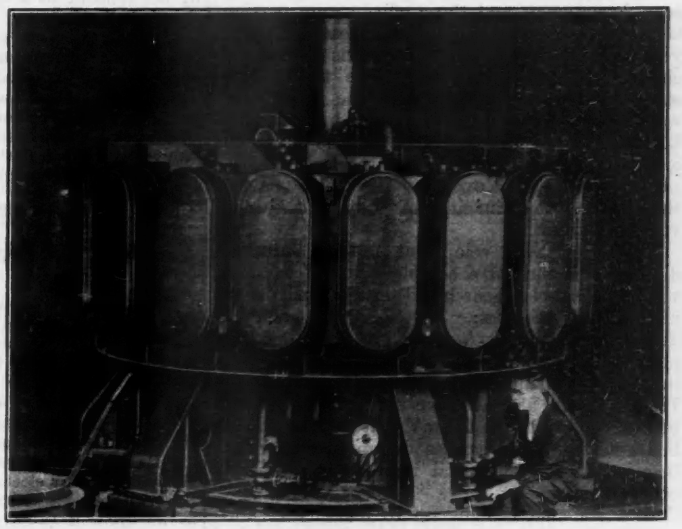


FIG. 2—22,200-KVA WATERWHEEL ALTERNATOR UNDER ERECTION—METROVICK

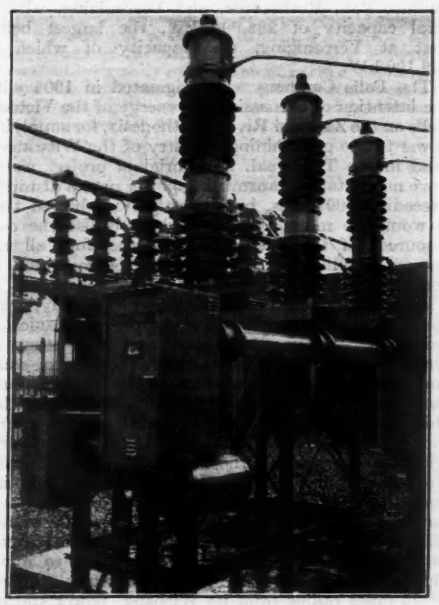


FIG. 3—66-KV OUTDOOR SWITCHGEAR—REYROLLE

Some 15,000 H.P. of large induction motors was built or ordered during the year for rolling mills and such applications. It is of special interest to observe that, in addition, 6000 H.P. of these A 1 motors have been utilised on high-frequency furnace equipments. In haulage work the robust pedestal-on-bearing-bracket type of induction motor has, it is stated, been preferred even for the smaller ratings.

About 9000 H.P. of synchronous induction motors was supplied or ordered during the year, a large proportion being "inverted," *i.e.*, rotor fed, a practice first introduced for low-tension motors by the company nearly twenty years ago.

The number of orders for D.C. machines received by the same firm was also well maintained. There has been a certain amount of winder work, power-house auxiliaries, &c., but owing to the present situation the major portion of the D.C. work was in connection with steel mills, and a large number of machines for marine service.

Switchgear

According to A. Reyrolle and Co., Ltd., there was a heavy demand for switchgear equipment for major power stations during 1940, and the developmental work involved to meet present-day requirements was extensive. The resulting advances in construction and performance are noteworthy. 132-kV power station equipment in South-East England will shortly be commissioned embodying single-break circuit breakers of small oil content associated with sequentially operated isolating devices and of very high speed operation. A striking feature in this design is the elimination of mechanical coupling between the operating mechanism and the circuit making and breaking contacts. The movement of the latter is effected by oil under high pressure from pumps solidly coupled to a pneumatic drive. One large power station 66-kV equipment was commissioned in South-East England, and one is in hand for a power station in North-East England, with completely metal-clad construction having phase separation and small oil content single-break circuit breakers with high-speed operation. The arrangement is such that by isolating the equipment for any individual circuit from the bus-bars the whole of the parts of that equipment can be made accessible for inspection, test, or renewal without disturbing the supply either to or from the remaining circuits. Parallel developments were made for outdoor constructions with similar characteristics in regard to oil content and speed of operation, and several orders are in hand. A portion of a typical installation is illustrated in Fig. 3.

Apart from work already mentioned, the firm has orders for the main and auxiliary switchgear of seven power stations in hand, including equipment of ratings from 500 mVA at 5 kV to 1500 mVA at 33 kV. In addition, equipment for two power stations was commissioned during the year. Medium-voltage switchgear to meet the more onerous short-circuit requirements now prevailing continues, it is stated, to be in increased demand both for supply authorities and for heavy industries.

Numerous export orders were obtained by the firm from sources that have purchased from foreign competitors in the past.

Present-day conditions, the Metrovick concern states, had their effects on the work of the switchgear department, and those effects were particularly noticeable in two dissimilar features of the year's work. Metal control conditions necessitated changes of design of detail parts to facilitate manufacture, and in such cases the opportunity was taken to improve the design and increase the accessibility of the equipment. The drive for export business was reflected in the large amount of equipment for overseas customers passing through the department, especially in the high-voltage division.

The principal development in the industrial division was that of a complete line of medium-voltage metal-clad gear based on the type "S F" mining gear designs. These units have been designed for purely industrial service and will not carry any flameproof certificates. The current ratings of the units range from 400 amperes to 1200 amperes, and all have a rated short-circuit breaking capacity of 25 mVA at 400 volts. As befits an industrial service design, provision has been made for the usual instrument and relay equipment.

In metal-clad designs up to 500 mVA short-circuit rating, it is noted, there has been a marked increase in demand for spring-operated closing mechanisms, especially for breakers at the top limit of the range—that is, 500 mVA at 33 kV. An outdoor mounting metal-clad isolating switch operating at 33 kV has been developed and manufactured, and this unit has been tested and shown capable of breaking its rated load current at this voltage. During the year two large installations of 66 kV metal-clad gear were completed for service, one being fitted with duplicate single-break oil circuit breakers on each circuit for bus-bar selection purposes. The reconstruction of old designs of circuit breakers in service still continues, and tests show that the fitting of cross-jet pots is the most effective factor in enabling the reconstructed breakers to meet the requirements of B.S. 116—1937.

During the year there was a considerable increase in orders for outdoor-mounting oil circuit breakers of the conventional oil tank design, with ancillary equipment for all ratings from 33 kV to 132 kV. Some of these equipments were for the Central Electricity Board to cope with the increased power demands on their system; but the majority were required for export contracts. Over 150 breakers have been ordered for export requirements, mainly to South Africa, Australia, and New Zealand.

(To be continued)

Sixty Years Ago

THE "ATALANTA"

THE "Juno," a sixth-rate warship of 923 tons, was built at Pembroke Dockyard to the designs of Sir William Symonds, Surveyor of the Navy, and was launched in 1844. In September of the following year she was commissioned for the Pacific station, where she spent three and a-half years. In February, 1849, she was paid off at Chatham. There she remained until September, 1853, when, after refitting, she was commissioned for the Australian station. Returning after four years' service overseas, she was again paid off. She remained in reserve until 1861, when she was fitted out as a water police vessel at Portsmouth. That service she continued to fulfil until 1877, in which year the Admiralty decided to train young ordinary seamen in a sailing ship without steam. The "Juno" was considered to be the only available vessel of the size and class considered suitable for that purpose. She was accordingly repaired and sent to Devonport to be fitted out as a training ship. On September 17th, 1878, after being renamed "Atalanta," she was commissioned by Captain Francis Stirling with a crew of 113 officers, seamen and artificers, besides 170 young ordinary seamen for training. A month later she sailed on a cruise to the West Indies. She returned to Portsmouth in September, 1879. Although she had experienced no bad weather during this cruise, 13 tons of ballast were, at Captain Stirling's request, added to the 30 tons which she already carried. On November 7th, 1879, she sailed on a second cruise to the West Indies. She arrived at Bermuda on January 29th, 1880, and, having completed provisioning, sailed for home on February 1st. She was never seen or heard of again. . . . . This tragedy, simple in its record, was the fate of many a ship in those days. It was, of course, investigated by an official committee. That committee's report, summarised in our issue of January 7th, 1881, indicated that the ship was addicted to heavy lurching, at times, it would seem, reaching an angle of 40 deg. or even more to the vertical. Nevertheless, her stability curve was considered to be satisfactory except at large angles of heel. Her stability, the committee reported, was considerably improved by her refitting as a training ship and by the additional ballasting and other alterations made just before her final cruise. . . . In the same issue we published a letter from Mr. (Sir) Nathaniel Barnaby, which was accompanied by a curve showing the ship's stability at various angles of heel. The righting moment had a maximum value at a heel of about 40 deg. and became zero at 96 deg. . . . The tragedy, like many others of the same kind, had thus to be written down as unexplained.

The Victoria Falls Power Company

THIRTY miles from Johannesburg the largest power station south of the Equator has been erected. It is the Klip generating station, the entire output of which is fed into the distributive system which carries power to the mines of the Witwatersrand. It has a capacity of 424,000 kW, and the need for so vast a station demonstrates the extent to which the gold mining industry of the Union is dependent for its efficient operation upon an abundant and cheap supply of electricity. It is an admitted fact that without electricity there could be no mining, as we know it to-day, and the full development of the Rand would not have been possible. Mining has now reached a depth of over 9000ft. below sea level, and that has only been possible because electricity has provided a means of driving the giant ventilating fans, hauling the ore, and pumping the water.

To supply the mines vast demands for energy there has been planned and carefully built upon the Rand what must rank as one of the largest regional distribution systems in the world. It is the distribution system of the Victoria Falls and Transvaal Power Company, Ltd., which draws its supply of power from six stations, two of which are owned by the Electricity Supply Commission. These are the Witbank station (110,000 kW) and the Klip station (424,000 kW). The generating stations of the Victoria Falls Company are at Brakpan, Simmer Pan, Rosherville, and Vereeniging, with a total capacity of 288,600 kW, the largest being that at Vereeniging, the capacity of which is 139,100 kW.

The Falls Company was originated in 1906 with the intention of harnessing the energy of the Victoria Falls on the Zambesi River, in Rhodesia, for supplying power to the gold mining industry of the Witwatersrand in the Transvaal. The original project would have necessitated transmitting power over a distance, exceeding 700 miles, but investigation showed that it would be more advantageous to utilise the coal resources of the Transvaal, and therefore all the energy supplied by the company is generated in coal-fired stations. Prior to the establishment of Victoria Falls and Transvaal Power Company, Ltd., there were two small power supply companies in existence, one near Brakpan and the other at Driehoek, near Germiston, and these two small companies formed the nucleus of the Victoria Falls Transvaal Power Company organisation. To-day this company supplies the electrical power requirements of the Witwatersrand gold mining industry, with the excepton of the Randfontein, East Rand Proprietary, and the New Kleinfontein gold mining companies. The Rand-Witbank system includes a large area in the Southern Transvaal and contains all the six stations referred to. The Electricity Supply Commission distributes electricity to municipalities, industries, and collieries within an area of 25 miles radius from its Witbank power station, and also to all railway property within 100 miles of the station. The system of the Victoria Falls and Transvaal Power Company, however, is situated within the area of supply granted to the Commission for its Rand extension undertaking. By agreement between the two organisations, the Witbank power station was erected and is operated for and on behalf of the Commission by Victoria Falls Power Company. Likewise, the Klip generating station has been erected by the Falls Company for and on behalf of the Electricity Supply Commission, and it is operating the station and distribution system for and on behalf of the Commission. The magnitude and importance of the Rand Witbank system is, to a large extent, the result of the close co-operation which always has existed between the V.F.P. and the Commission for maintaining a reliable, efficient, and economical supply of electric power.

The whole of the Reef distribution system is interlinked, so that in the event of the failure of any generating unit or a breakdown on any of the transmission lines, there need be no prolonged stoppage of work on any of the mines. The importance of an uninterrupted supply of electricity to the industry has, of course, always been the major concern, and a very considerable amount of research work has been carried out in connection with lightning storms of varying severity. It has been shown that as many as 200 such storms may be experienced over the area of the system during a single season, and it has been necessary to duplicate and in some cases quadruplicate the feeders and interconnectors to important consumers. However, as the result of the installation of highly specialised automatic devices, 85 per cent. of the lightning faults which are experienced on the system leave the affected line immediately available for service, and accordingly automatic reclosing switches have been installed. These devices switch the "tripped" line automatically back into service.

So rapid is the expansion of demand that although the new Klip station only came into full service in 1939, it has been necessary to undertake the erection of a new power station on the bank of the Vaal River. The station is designed for an installed capacity of 100,000 kW. The station will be the property of the Electricity Supply Commission, but will be operated by the Victoria Falls Power Company, which will take the whole of the output. It is possible that owing to the war conditions delivery of the plant will be delayed. Progress has been satisfactory on the construction of the circulating water system, including the two hyperbolic cooling towers, each 320ft. high, coal appliances, and railway sidings. Water will be drawn from the Vaal River under agreement with the Rand Water Board.

New Year Honours

IN the official list of New Year Honours bestowed by the King the following names appear:—Knighthoods are conferred upon Mr. Peter Frederick B. Bennett, Past-President of the Federation of British Industries, and lately Director-General of Tanks and Transport in the Ministry of Supply; Dr. James Weir French, chairman of Barr and Stroud Ltd., Glasgow; Mr. Allen John Grant, managing director of Thomas Firth and John Brown, Ltd., Sheffield; Mr. William Frederick Leggett, Chief Industrial Commissioner in the Ministry of Labour and National Service; Mr. Ernest John H. Lemon, Vice-President of the London Midland and Scottish Railway Company; Mr. Samuel Osborn, Chairman of the Sheffield Juvenile Advisory Committee and director of Samuel Osborn, Ltd., of Sheffield, and Mr. Frank Spencer Spriggs, managing director of Hawker Siddeley Aircraft Company, and President of the Society of British Aircraft Constructors, Ltd.

The Order of K.C.B. in the Civil Division is conferred upon Dr. Edward Victor Appleton, F.R.S., Secretary of the Department of Scientific and Industrial Research, and Mr. Charles Northrup McLaren, Director-General of Ordnance Factories, the Ministry of Supply. Mr. James Scott Pringle and Mr. Robert Alexander W. Watt, Scientific Adviser on Telecommunications in the Ministry of Aircraft Production, become C.B. in the Civil Division. In the Order of the British Empire the following Civil Awards have been made:—Sir William Arthur Robinson, lately Secretary of the Ministry of Supply, becomes G.B.E., and Sir Allan Gordon Gordon-Smith, managing director of S. Smith and Sons (Motor Accessories), Ltd., K.B.E. The Order of C.B.E. is conferred upon Mr. George Edwin Bailey, M.I. Mech. E., managing director of Metropolitan-Vickers Electrical Company, Ltd., Manchester; Mr. Sydney Camm, chief designer, Hawker Aircraft, Ltd.; Mr. Cecil Bertram Davies, M.Inst.E. Aust., a prominent consulting engineer in Tasmania; Mr. Albert George Elliott, chief engineer (aero division), Rolls-Royce, Ltd.; Mr. Reginald Thomas George French, Secretary of the Electricity Commission; Mr. Sydney Emile Garcke, member of the Transport Advisory Council, and vice-chairman of the Tilling and British Automobile Company, Ltd.; Mr. Thomas Mackenzie, general manager of Metal Industries, Ltd., Lyness and Orkney, Chief Salvage Officer, Orkneys and Shetlands; Mr. Herbert John B. Manzoni, City Engineer and Surveyor of Birmingham; Mr. Edward David Meryon, Director of Contract Work, Admiralty, and Mr. Norman Rowbotham, works manager, aero engine department, Bristol Aeroplane Company, Ltd. In the Order of St. Michael and St. George, Lieut.-Colonel John Henry Maitland Greenly, C.B.E., chairman of Babcock and Wilcox, Ltd., and formerly Controller-General, British Supply Board in Canada, and Chairman of the Prime Minister's Panel of Industrialists, 1938–1939, becomes a Knight-Commander.

A GERMAN SCHEME POSTPONED.—The German Minister of Transport has decided that the intended amalgamation of the Berlin and Munich Reichsbahn divisional managements shall not take place. The reason given is that the incorporation of the Austrian, Czech, and Polish lines has increased the total area of the system to such an extent that separate administrations remain desirable.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer.

New Iron and Steel Control Moves

As from December 29th, under a detailed allocation scheme which has been evolved by the Iron and Steel Control, all deliveries of hematite pig iron will be allocated and producers nominated. This step is necessary as a result of changes in the production programmes of some hematite producers and the additional necessity of tying up deliveries of imported iron with home-produced iron. The scheme will guarantee more effective distribution and will be welcomed by consumers, ensuring, as it does, a specific weekly tonnage. All the varying qualities of hematite have been covered in order that special requirements can be safeguarded. Ordinary commercial contacts between buyer and seller will remain in so far as contracts and specific delivery details are concerned, although the tonnage indicated by the Control will represent a maximum for the period, unless there are special circumstances requiring review. It is understood that hematite will only be released for purposes where no other alternative material can be substituted. This decision will affect a number of ironfoundries. A supply of low-phosphorus foundry iron will be available, although a strict watch will continue to be kept on the consumption of this quality. Refined irons, as a further alternative for hematite, are in reasonable supply. The output of phosphoric foundry iron is maintained at the consumption level and an adequate margin for a working stock is now being granted to all those consumers on essential work. Very little iron, if any, is being released for the production of castings of a domestic nature. It is also announced that the Iron and Steel Control have been asked by the Ministry of Supply to take a complete census of the stocks of steel held by users. The inquiry will relate to the stock position at the end of December, and the form sent out by the Iron and Steel Control will require to be completed and returned by January 11th, so that the results will be available by the middle of the month. In addition to stocks, the total receipts and consumption of steel in the last quarter of 1940 will be asked for. The list of firms who are being written to has been built up from lists of customers of representative steel firms in each area, and although the number of firms being approached runs into many tens of thousands, some important, though not necessarily large, users of steel, may have been omitted. As it is most desirable that every user of steel should be covered by the inquiry and should be on the Control's list of steel consumers, any firm that has not been written to within the first few days of January is asked to write to the Iron and Steel Control, Hemingford, Alveston, near Stratford-on-Avon, for the necessary form.

November Exports

The Board of Trade Returns for November in their war-time form show that the total exports during that month amounted in value to £21,666,181, a decrease of £15,694,146 compared with November last year and of £21,257,042 from the 1938 total. Our exports of coal in November were valued at £702,004, which was £3,141,151 less than in the same month of 1939. The exports of non-metalliferous mining and quarry products and the like reached in value £13,874, which was £121,268 lower than in the corresponding month of 1939. Iron ore and scrap were exported to the value of £1760, a reduction on the value of similar exports in November last year of £2396. The value of non-ferrous metalliferous ores and scrap exported was £1379, or £41,470 below the value of the exports in November, 1939. Iron and steel and manufactures thereof were exported to the value of £1,744,715, which was £470,390 less than for the corresponding month of 1939. The exports of non-ferrous metals and manufactures thereof totalled £673,083, a drop of £113,739 from the November, 1939, exports. Cutlery, hardware, implements and instruments were exported to the value of £507,507, or £303,075 below the value of similar exports in November last year. Exports of electrical goods and apparatus amounted to £710,657, which was £205,113 less than in the corresponding period of 1939. Machinery in November was exported to the value of £2,050,266, which showed a reduction, when compared with the value of the November, 1939, exports, of £1,246,412. The value of the exports of locomotives, ships and aircraft totalled £2,104,592, or £513,383 less than in November of last year.

Our Imports in November

The total imports of all categories of goods in November amounted in value to £72,930,436, compared with £84,042,757 in November, 1939, a reduction of £11,112,321; and of £5,043,182, compared with the November, 1938, total. The imports of non-metalliferous mining and quarry products and the like were valued at £540,182, which was an increase of £23,332 over the corresponding month of 1939. Iron ore and scrap were imported to the value of £1,007,094, a rise of £143,724 over the value of similar imports in November, 1939. The imports of non-ferrous metalliferous ores and scrap in November were valued at £2,256,948, which was £34,625 more than in November, 1939. The value of the imports of iron and steel and manufactures thereof at £7,203,037 were £4,973,753 above the imports in November last year. Non-ferrous metals and manufactures thereof were imported to the value of £4,336,225, a rise, when compared with November, 1939, of £1,349,940. The value of cutlery, hardware, implements and instruments imported totalled £201,472, a decrease of £94,771 compared with those of November, 1939. Electrical goods and apparatus were imported in November to the value of £127,423, or £101,430 less than for the corresponding month last year. Imports of machinery reached £3,553,202, a rise of £1,621,368 over the imports of similar goods in November last year. Vehicles, including locomotives, ships and aircraft, were imported to the value of £2,577,204, an increase of £852,008 over similar imports in the corresponding period of 1939.

Copper and Copper Alloys

In a circular dated December 12th, 1940, the Non-Ferrous Metals Control makes the following announcement:—Copper and Copper Alloys for Gas Appliances, "N.F.G."—Commencing from January 1st, 1941, the following alterations are made to the arrangements set out in the Non-Ferrous Metal Control's circular letter of June 6th. The weight of copper and copper alloys to be used by any manufacturer in the production of the articles listed under paragraph (*b*) of that circular letter is to be restricted to 10 per cent. of the tonnage used by the manufacturer in the year ended June 30th, 1939. These articles comprise gas water heaters of all types, wash boilers and washing machines. This 10 per cent. quota is granted for home civil trade. Requirements for export and for Government Departments should be applied for separately and will be considered on their merits. It should be noted that the definition "Government Departments" in this particular instance is to be taken to include not only the Service Departments, *i.e.*, the Ministry of Supply, War Office, Admiralty and Air Ministry, but also all other Government Departments. The tonnage of metal obtained by a manufacturer during any one-quarter of a year must not exceed one-quarter of the annual quota allowed on the above basis. Apart from these alterations, the other restrictions and conditions set out in the letter of June 6th still apply. Manufacturers who adhere to the scheme set out in the circular letter of June 6th, as amended in this letter, should quote the symbol "N.F.G. 1941" when ordering from their suppliers, who must, in turn, quote this symbol on the schedules which they submit to the Non-Ferrous Metals Control.

The Pig Iron Market

Suspensions in deliveries this Christmas were on a far smaller scale than is usual, as the majority of the consuming works carried on throughout the holiday. The demand also has slackened lately, although the break of one day, which most of the consuming industries indulged in, naturally acted as a check upon some of the negotiations in progress. The Control appears to have given licences with more freedom and consumers, both before and after Christmas, were arranging for deliveries over the first quarter. At some of the works it has been possible to collect a small reserve, and this has given satisfaction to users in view of the possibility of seasonal interruptions to transport. There has been considerable activity in the foundry iron department and the principal demand has been for high-phosphoric grades, although recently the low phosphoric descriptions have been given more attention. This is because the light castings foundries are busier than they have been for some months. Work is distributed amongst them somewhat unevenly and there is still a great deal of short time, but more of them have been brought into the war effort and, at the same time, there has been a rather broader demand from the building trades. The engineering establishments are almost all engaged upon war work and their requirements of foundry iron, including high-phosphoric, refined and hematite, have been on a large scale. Although there is no great surplus after consumers' requirements have been met, the situation in this department is distinctly better than it was in the early autumn. Recent imports of hematite have greatly relieved the situation and no anxiety is now felt as to future supplies. The steel works are using large quantities of basic iron and the production of this description by the home makers is at a high level. Nevertheless, it has been considered wise to import large tonnages, and this has assured that supplies of basic to the steel works will be sufficient to meet all needs.

Scotland and the North

There was no slackening at the iron and steel works, such as usually occurs at this season. Production was maintained at an exceptionally high level. Many consumers urgently pressed for delivery of orders, as they were anxious to complete contracts, if possible, before the fourth delivery period expired on December 31st. In most cases, however, the works will carry over important tonnages of undelivered orders into 1941. The year closed with a large volume of inquiry in circulation, so that the makers are unlikely to experience any relief from the pressure they have experienced from consumers during the past twelve months. The vast proportion of the work in hand at the steel mills is on Government account and for high-priority users, and so far as can be seen customers requiring steel for non-essential purposes will be no better off in the New Year than they were in 1940. The chief consuming industries in Scotland are fully committed for a long time to come. In particular the shipyards and boiler and tank makers are big users of plates and some tightness in this department exists. Marine engineers and other engineering establishments are requiring large quantities of special and alloy steels and most of the producing works have increased their output of these steels. There is still a strong request for sections, principally of the smaller sizes, and the re-rolling works are fully booked for a long period. Apparently they are receiving full supplies of billets as the Control has arranged considerable imports. The home production of billets and sheet bars has also reached important proportions. Lancashire steel makers report a steady stream of specifications for practically all descriptions of finished steel. A feature of the demand has been the increased requirements of special and alloy steels which are largely used by the munition makers. Black and bright bars are also in request and a big business is passing in this department. There is a rather quieter call for the heavier joists and sections; but, on the other hand, the demand for the lighter sections has strengthened. The works on the North-West Coast are working to capacity and are producing big tonnages of steel for a wide range of consumers.

The Non-Ferrous Metal Markets

Little business was transacted over the Christmas holidays in non-ferrous metals. The London Metal Exchange was closed on Christmas Eve and re-opened on December 27th, but transactions were comparatively few and most consumers had prepared for the holidays by taking somewhat larger deliveries prior to the break. The position of the copper market has not varied, and so far as Great Britain is concerned may be regarded as satisfactory. Whilst a rigid control may be anathema to the majority of traders, its necessity in war time cannot be disputed, and it is to the credit of the Control that throughout the war it has been able to maintain regular supplies to the firms engaged upon war work. In the United States the domestic price is retained at 12c. d/d and consumption has greatly expanded during the past few weeks. The export price was raised from 10¼c. to 10⅝c., f.a.s., but later the market became easier, and whilst the general quotation seemed to be 10⅜c., business could probably have been done following the holidays at 10¼c., f.a.s. There has been a fair amount of inquiry from Russia and Japan and the latter country is said to have placed some orders at 12c., f.a.s., although the contract is understood to have made delivery conditional upon no embargo being placed upon the export of metal. Quiet conditions have ruled in the tin market. The issue of export licences has not been resumed by Great Britain, and whilst prices have fluctuated transactions have been few and the market has developed no fresh characteristic. Business in lead also has been suspended over the holidays and, as in the case of other non-ferrous metals, consumers took the precaution of laying in supplies prior to the holiday. In the United States the quotation remains unchanged at 5½c., New York, and whilst consumption is good there does not appear to be any stringency in the market. In spelter, however, some tightness rules in the United States and the domestic price remains at the comparatively high figure of 7½c. Apparently there is no spelter available in the United States for export, and although Japan has bid high prices it is understood that no business has resulted.

Non-Ferrous Metal Prices

The London Metal Exchange official average prices for December show that the cash quotation for tin dropped £1 4s. 9d., compared with the average for November, whilst for three months' metal there was a drop of 5s. 4d. The settlement average was £1 5s. 2d. lower than in December. The statement, which includes the official maximum prices for copper, lead and spelter, is as follows:

Standard tin	Cash (mean)	£257 2 9
	Three Months (mean) ...	£259 19 9
	Settlement	£257 1 3

The following prices for copper, lead and spelter are the maximum prices fixed by the Controller of Non-Ferrous Metals:—

	£ s. d.	
Standard copper	—	
Electrolytic copper ...	62 0 0	delivered buyers' premises
Electrolytic wire bars ...	62 0 0	,, ,, ,,
Best selected copper ...	60 10 0	,, ,, ,,
Lead, good soft pig ...	25 0 0	,, ,, ,,
(foreign)		(duty paid)
Spelter, G.O.B. (foreign)	25 15 0	delivered buyers' premises (duty paid)

CALENDARS, DIARIES, &c.

ASHWELL AND NESBIT, Ltd., Barkby Road, Leicester.—Wall calendar showing an etching of St. Bartholomew's Gatehouse, Smithfield.

ASSOCIATED EQUIPMENT COMPANY, Ltd., Southall, Middlesex.—Desk engagement pad and copy of "Motorists' Diary."

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Wall calendar with tear-off sheets for past, current and next months, and also showing past, current and next years.

FERODO, Ltd., Chapel-en-le-Frith.—Wall calendar with colour view, "Ploughing in the Pennines," by Michael Reilly.

GEAR GRINDING COMPANY, Ltd., Shirley, Birmingham.—Wall calendar showing past, current and next months.

HACKBRIDGE ELECTRIC CONSTRUCTION COMPANY, Ltd., and HEWITTIC ELECTRIC COMPANY, Ltd., Walton-on-Thames, Surrey.—Refill for engagement pad.

HIGH DUTY ALLOYS, Ltd., Trading Estate, Slough.—Diary for 1941, containing details of the firm's alloys and other technical data.

C. A. PARSONS AND CO., Ltd., Heaton Works, Newcastle-upon-Tyne.—Wall calendar giving views of the firm's products.

RAYBESTOS-BELACO, Ltd., Asbestos House, Southwark Street, S.E.1.—Pictorial calendar with daily tear-off sheets.

ROBEY AND CO., Ltd., Globe Works, Lincoln.—Wall calendar with monthly tear-off sheets.

RUSTON AND HORNBY, Ltd., Lincoln.—Photographic wall calendar showing past, current and next months.

RUSTON-BUCYRUS, Ltd., Lincoln.—Pictorial wall calendar showing past, current and next months.

HENRY SIMON, Ltd., Cheadle Heath, Stockport.—Desk calendar with daily tear-off slips, each bearing a quotation.

S. S. STOTT, Ltd., Haslingden, Rossendale, Lancs.—Desk calendar with daily tear-off slips.

EDWARD WOOD AND CO., Ltd., 68, Victoria Street, S.W.1.—Diary for 1941 containing miscellaneous technical data and tables.

CEMENTED CARBIDES.—A paper on the manufacture and use of cemented carbides by Mr. H. Burden, of the Brown-Firth laboratories, read before the Institute of Production Engineers, has been published in booklet form by Thos. Firth and John Brown, Ltd., Sheffield.

Notes and Memoranda

Rail and Road

PASSENGER TRAIN SERVICES.—The Ministry of Transport announces that heavy movements of coal which are required at this time of the year, combined with the greatly increased freight traffic upon the railways as a result of the nation's war effort, may make it necessary to effect some temporary reductions in certain passenger services in London and in the provinces. The railway companies concerned will give notice locally in the usual way of the particular services affected.

TO ENCOURAGE ROAD TRANSPORT.—The Minister of Transport has sent a letter, through the Regional Transport Commissioners, to sub-district transport managers, in which he intimates that he has decided, as a matter of policy, that there should be a diversion of suitable traffics from the railways to road, canal transport, or coastal shipping. Sub-district managers are also notified that additional grants of petrol may be made to road hauliers for the carriage of goods in approved circumstances.

REPLACING A BRIDGE.—Recently a railway span weighing in all nearly 500 tons of steel was placed in position over the Yonge Street highway, on the Canadian National Railways' main transcontinental line at the entrance to Aurora, in record time. It took eight men, directed by a foreman, with two winches and derricks, only twelve minutes to move out the old bridge. The new one was in position in six minutes, without interruption to train service. It has been specially designed with girders 120ft. in length.

WAGON SHEETS.—In the House of Commons, Mr. J. J. Davidson, a Scottish Labour Member, has asked the Minister of Transport if he had considered the statement sent to him on November 8th, 1940, by the Association of Jute Spinners and Manufacturers referring to the use of jute wagon covers for sheeting. The Minister for Transport replied that a special method of proofing jute canvas had been developed and that limited quantities of this canvas were being used for wagon sheeting as a temporary expedient. Other more suitable substitutes for flax sheeting, such as cotton duck, were becoming increasingly available.

A MUSEUM PIECE.—The Canadian National Railways have recently acquired an addition to their collection of articles of historical interest. It is the lantern that was in use on the Champlain and St. Lawrence Railroad, the first passenger line in Canada, and now part of the Canadian National Railways. When Mr. John Hebert retired from a long career as an engine driver, he carried away the lantern as a souvenir, as well as a brass torch used in the Grand Trunk period. These articles passed into the possession of his son, Mr. D. Hebert, who has given them to the Museum. Father and son between them were employed ninety-seven years by the Canadian National and predecessor companies.

CYLINDER BORES.—A recent issue of the *Journal* of the American Society of Automotive Engineers contained a summary of the effect of the various elements of cast iron on its microstructure when other variables are considered constant. It has been shown that silicon and carbon soften the iron; that manganese aids in controlling the effect of sulphur; that high phosphorus content tends to make the iron brittle, but hard phosphide inclusions retard wear; that nickel acts as a graphitiser, promoting machinability; that chromium forms stable carbons; and that molybdenum promotes strength. It is concluded that cast irons with normal flake graphite give the best wear; those with large amounts of ferrite give poor wear; irons with ferrite-fine graphite structure give the worst wear; and irons with excessively coarse graphite give porous bores.

THE SPLITTING OF SLEEPERS.—The problem of split railway sleepers has been the subject of recent inquiry in America. Control of the rate of drying of the timber seems to be the first step. If it were possible to season sleepers in such a way that the loss of moisture were uniform throughout their cross section, shrinkage stresses would be eliminated; but the cost of kiln-drying timber in such sizes as sleepers, for this purpose, is prohibitive. Short of this, considerable importance attaches to the method of stacking sleepers during the seasoning period, in order to facilitate the circulation of air, which, in its turn, controls the speed at which the evaporated moisture is carried away. Vertical circulation of air is of the utmost importance, and this is promoted by good horizontal circulation beneath and around the bottom of the sleeper stacks. Certain varieties of timber split more readily than others, so that the loss from badly split sleepers can also be minimised by more careful selection of the timber used for sleeper purposes.

Air and Water

UNITED STATES NAVY AIRSHIPS.—It is announced that the United States Navy has ordered from the Goodyear Aircraft Corporation six non-rigid airships for training and patrol purposes. These are the first batch out of a total of forty-eight authorised.

PANAMA NEWS.—It is reported from Washington that five firms have tendered for the work of excavating a third set of locks on the Panama Canal, which will eventually cost nearly 300,000,000 dollars. Work on a new bombproof pass for warships will start in a few weeks, the preliminary surveys having already been made.

R.A.F. REQUIRES ENGINEERS AND TECHNICAL OFFICERS.—It is announced that the Royal Air Force still has vacancies for technical officers on engineering, armament, and signal duties. Commissions in the R.A.F.V.R. will be granted for the duration of hostilities to suitable applicants between the ages of twenty-one and fifty years who possess the requisite personal and technical qualifications. Candidates should apply at once in writing to the Air Ministry, S 7 (e) I, Adastral House, Kingsway, W.C.2, giving full particulars of their qualifications, training, and experience. Candidates who have previously applied are requested not to renew their applications.

A CORROSION NOTE.—Among some recent notes on investigations into the causes of the corrosion of metals used in aircraft, made by the National Bureau of Standards, is one dealing with the corrosion of aluminium alloys of the duralumin type. Two distinct types are discussed—surface pitting and intercrystalline attack. The former is reduced by keeping the iron and copper content low (at a small sacrifice of strength), whilst intercrystalline corrosion can be entirely avoided by suitable heat treatment.

SHIPBUILDING IN AUSTRALIA.—The effort to establish shipbuilding in Australia is hampered by the lack of skilled labour. Only a limited number of British shipyard workers emigrated during the post-war slump. On the other hand, a number of Maltese emigrated to Australia and these included shipwrights and other skilled ratings from Malta Dockyard whose engagements had been terminated during the general cutting down. Many went to work on farms, and others drifted into the general labour market. But they retain their experience, and now, although out of practice, some of them are re-entering their old trade.

A MONSTER HOSE.—What is believed to be the biggest flexible hose ever made has just been completed by the Boston Woven Hose and Rubber Company, Cambridge, Mass. It will be used on a hydraulic dredge for channel clearing operations on the Mississippi River. The hose, 20ft. 10in. long, weighs 9800 lb. In its manufacture 3500 lb. of rubber, 800 lb. of cotton, and 2700 lb. of wire were required. The hose will serve as a flexible joint between the dredge ladder and the suction line, and is designed for a maximum bend of 42 deg. The thickness of the walls is 3½in. The work was done on a boiler plate mandrel designed by the company.

MERCHANT SHIPPING (FIRE APPLIANCES) RULES.—The Minister of Shipping has announced the issue of the Merchant Shipping (Fire Appliances) Rules, 1940, which supplement the Merchant Shipping (Fire Appliances) Rules, 1932, and came into operation on January 1st. The new Rules add to the requirements applicable under the previous Rules to passenger ships, and they impose compulsory requirements upon all sea-going merchant ships, except sailing ships and fishing vessels. The Rules include a power to grant exemption from any of their requirements, if the Minister is satisfied that such requirements are either impracticable or unreasonable. It is proposed to exempt existing ships from certain of the requirements so far as they would involve extensive structural alterations to the ships.

Miscellanea

COAL DISCOVERY IN SWITZERLAND.—Considerable importance is attached to the discovery of an anthracite field in the Loetschental Valley, Valais, Switzerland. The discovery makes particularly welcome news to the Swiss, who are suffering severely from coal shortage.

MANCHURIAN MANGANESE DEPOSIT.—The Manchuria Mining Development Company has reported the discovery of manganese deposits at Hsihsien, Chinchow Province, estimated to contain 10,000,000 tons. A company with a capitalisation of 5,000,000 yen is to be formed to exploit the deposits.

A RECORD RUN.—The 600-ton No. 2 blast-furnace at the Otis Steel Company's Riverside Works, Cleveland, U.S.A., has just been shut down after a ten-year continuous run. This is believed to be the longest continuous run for a blast-furnace anywhere or at any time. The output was 1,735,500 long tons of iron.

THE MERCURY POSITION.—Mercury output in America continues to increase, and with a monthly production of about 3500 flasks it is nearly double the output in January. At the beginning of November the U.S. Navy Department called for tenders for some 90,000 lb. of yellow oxide of mercury, equivalent, approximately, to a thousand flasks of the metal.

ALUMINIUM FOR JAPAN.—One of four aluminium plants under construction by the Japan Light Metals Manufacturing Company at Kambara, Shizuoka Prefecture, has now been completed. The company does not make its own alumina, but utilises the surplus output of the Showa Electro Industrial Company and the Japan Aluminium Company, in addition to imported alumina when available.

DIAMOND DIE CONTROL.—The Minister of Supply has issued the Control of Diamond Wire-Drawing Dies (No. 1) Order, which came into force on January 1st. This Order provides that no person shall acquire mounted or unmounted diamond wire-drawing dies except from the Minister of Supply or under an authority issued by him, and that no person shall dispose of such dies except to the Minister or to a person who is authorised to acquire. Also, no person shall produce such dies except under authority.

ELECTRICAL SUPPLY REGULATIONS IN SOUTH AFRICA.—Nine years ago there was set up in South Africa a committee which was to work out standard electrical supply regulations. The committee as constituted represented the following bodies, each of which nominated its own representatives:—The Institute of Certificated Engineers, South Africa; the Association of Municipal Electricity Undertakings of South Africa and Rhodesia; the South African Institute of Electrical Engineers; the Electricity Supply Commission, and the National Federation of Building Trade Employers. By 1937 some of its findings were completed, and the Association of Municipal Electricity Undertakings of South Africa and Rhodesia accepted this draft at the Cape Town Convention held in December, 1938. Further difficulties arose, but at long last, all the preliminary work has been completed, and it is hoped that within the near future every city, town, and village in the Union will be legally in possession of a standard set of regulations. The "Wiring Regulations" is now in the hands of the translators prior to being printed by the South African Institute of Electrical Engineers. Orders for over 800 copies have been received from local authorities who have agreed to participate in a "group promulgation."

A SOVIET MOLYBDENUM SMELTER.—A molybdenum smelter—the first in the Soviet Union—is expected to begin production before the end of this year. It is on Lake Balkhash in Kazakstan, and will be attached to the Balkhash copper smelter and will extract the molybdenum contained in the concentrates of the copper ore mined at Kounrad, north of Lake Balkhash. The Kounrad copper-porphyry mine supplies ore for the Balkhash copper combine, the biggest operating Soviet copper smelter, which started output in 1938.

MINERS' SCHOLARSHIPS.—Trustees of the miners' welfare national mining education scheme have awarded thirty-one scholarships for part-time day advanced mining courses. This is six more than were awarded last year, when the scheme was first started. These scholarships are intended to assist suitably qualified workers to attend advanced courses in mining, leading up to the colliery manager's first or second class certificate of competency examinations of the Mines Department. They are worth up to £20 each in respect of fees, books, and travelling expenses.

TIN SUPPLIES IN SOUTH AFRICA.—At the Mineral Research Laboratory maintained by the Government of South Africa work has been going on for the past two years for the treatment of tin ore with a new type of rotary furnace. It was found possible to volatilise and extract the tin content to a high degree from ores otherwise untreatable. A relatively high temperature, however, was found to be necessary which, in turn, introduced difficulties. During the past year most of the difficulties experienced with the process were overcome, although the composition of certain tin ores renders manipulation rather complex. Volatilisation was attempted by other methods, but these were unsatisfactory. Attention was also paid to the smelting of low-grade concentrate, and the subsequent treatment of the iron-tin alloy produced gave promising results.

MINERALS IN EGYPT.—The international situation has brought into prominence the mineral resources of Egypt. In recent years systematic efforts have been made to facilitate mineral discovery and development. Petroleum, manganese ore, and phosphates are among mineral products of the country. Minor products are ochres, sulphate of magnesium, talc, gypsum, natron, salt, beryl, and sulphur. Apart from some gold, the metals include copper ore, wolfram, and molybdenum. Of particular interest are the zinc-copper mines of Abu Hamamid, where new workings have been opened in the side of a low hill where the ancient Egyptians worked malachite. Tin deposits, estimated at some 500,000 tons, have been discovered on the Red Sea coast, and official anticipations are that these mines should produce about 15,000 tons of pure tin annually.

Personal and Business

ALLDAYS AND ONIONS, Ltd., inform us that their London office address is now 2, Queen Anne's Gate, Westminster, S.W.1.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., has announced the appointment of Admiral H. W. Grant, C.B., as chairman and managing director.

MR. F. R. POTTER, Superintendent of the Line, Great Western Railway, retired on December 31st after forty-five years' service with the company. He is succeeded by Mr. G. Matthews.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Fuel Luncheon Club

Wednesday, Jan. 8th.—Connaught Rooms, Great Queen Street, W.C.2. Luncheon, 12.45 for 1.10 p.m. Address, H. G. Austin.

Institution of Chemical Engineers

Tuesday, Jan. 14th.—Geological Society's Rooms, Burlington House, Piccadilly, W.1. "Modern Developments in the Design of Plant for the Concentration of Sulphuric Acid," P. Parrish. 2.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Jan. 14th.—39, Elmbank Crescent, Glasgow. "District Heating," D. V. H. Smith. 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 3rd.—Storey's Gate, Westminster, S.W.1. "The Control of Oil Fires," A. F. Dabell. 2 p.m.

Manchester Association of Engineers

Friday, Jan. 10th.—Engineers' Club, Albert Square, Manchester. "Woodworking Machinery: Recent Developments in Design," R. H. Buckley. 7.15 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Jan. 17th.—Mining Institute, Newcastle-upon-Tyne. "Optical Instruments: Particularly Large Astronomical Telescopes," G. E. Manville. 6 p.m.

Royal Society of Arts

Wednesday, Jan. 15th.—John Adam Street, Adelphi, W.C.2. "Women in Industry," Miss C. Haslett. 1.45 p.m.